BIOLOGICAL ASSESSMENT

For

Columbia River Bull Trout

Snake River Steelhead Trout

Snake River Fall Chinook Salmon

Snake River Spring/Summer Chinook Salmon

Sockeye Salmon

Essential Fish Habitat

Lolo Insect and Disease Project

Alternative 5 Modified

U.S. Department of Agriculture
Forest Service
Nez Perce-Clearwater National Forests
Lochsa Ranger District

Karen A. Smith
Nez Perce- Clearwater National Forests
Fisheries Biologist

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Executive Summary

Brief description of project

The Lolo Insect and Disease Project (LID) occurs in the upper Lolo watershed where the USDA Forest Service manages approximately 80,000 acres of the 158,000 acre watershed. Between approximately 1940 and 1995, extensive roading and vegetation management has occurred across most of public and private lands in this watershed. Lolo Watershed contains one of 5 steelhead populations in the Clearwater Sub-basin that must be stabilized and increased for steelhead in this sub-basin to be considered recovered under the ESA. Currently, in addition to out of sub-basin factors negatively affecting the Clearwater Sub-basin meta-population, historic degradation in the Lolo watershed along with hatchery practices are identified as threats to steelhead recovery.

In recognition of out-year planning for the LID project, and a need to reduce road related effects within the watershed, the Lochsa Ranger District completed NEPA for a project called "Lolo 1st 50" in 2014. The project is reducing the size of the road network and its effect on watershed function. The First 50 project decision abandoned use on 66 miles of road prism in the Lolo watershed. The decision prescribed treatments that remove 96 crossings of which 7 are within 600 feet of steelhead critical habitat. At a minimum, road prisms are de-compacted and when necessary, prisms are re-contoured. All 1st 50 treatments are expected to be completed by 2020.

LID would conduct insect and disease damaged salvage timber harvest on almost 3400 acres, producing approximately 43 million board feet. All harvest occurs outside of RHCAs. The project would build small amounts of both permanent (less than 1 mile) and temporary road construction (14 miles), road reconstruction and 44 miles of road decommissioning on Forest Service lands within the Lolo Creek watershed. Planting of more resistant species would follow harvest. The greatest potential for sediment delivery during the project comes from haul on approximately 70 miles of mostly improved road surface within RHCAS.

Road reconstruction and decommissioning are designed to minimize sediment input into streams over the long term by at least 9% as compared to current conditions. A small section of OHV trail would also be constructed in order to provide a loop opportunity for recreationists. Weed spraying would not be authorized with this project but may occur as authorized by other NEPA decisions.

Determinations

Table 1: Determinations for Analyzed Species

Species – ESA Listed/Proposed	**Determination**
Columbia River Bull Trout	May affect, not likely to adversely affect
Columbia River Bull Trout Designated Critical Habitat	No Effect
Snake River Steelhead Trout	May affect, likely to adversely affect
Snake River Steelhead Trout Designated Critical Habitat	May affect, likely to adversely affect
Snake River Fall Chinook Salmon	No Effect
Snake River Fall Chinook Salmon Designated Critical Habitat	No Effect
Spring/summer Chinook Salmon	No Effect
Sockeye Salmon	No Effect
Essential Fish Habitat	May affect, likely to adversely affect

I. Introduction

Forest Service lands within the Lolo Creek watershed are experiencing increased tree mortality as a result of insects and disease, particularly in stands dominated by grand fir and Douglas-fir species. The Nez Perce–Clearwater National Forests is proposing to harvest the dead, dying and high risk trees (Scott, 2002) in order to recover their economic value. Harvested areas would be reforested with more resistant and resilient tree species. Harvest is expected to increase the amount of early seral habitat important for many wildlife species. Harvest includes the need for temporary and permanent road construction to access harvest units. Road work including reconditioning, storage, and decommissioning would be used to minimize road-related effects to fish and their habitat.

The Endangered Species Act of 1973 directs federal agencies to conserve Endangered and Threatened Species and to ensure that federal actions authorized, funded, and carried out are not likely to jeopardize their continued existence or result in the destruction or adverse modification of critical habitat. In response to Section 7(c) of the Endangered Species Act and Forest Service Manual (FSM) 2670, this biological assessment displays the potential effects of conducting project activities upon Threatened and Endangered Species that are known or may occur in the project areas.

This consultation is based on the actions as proposed for Alternative 5 Modified.

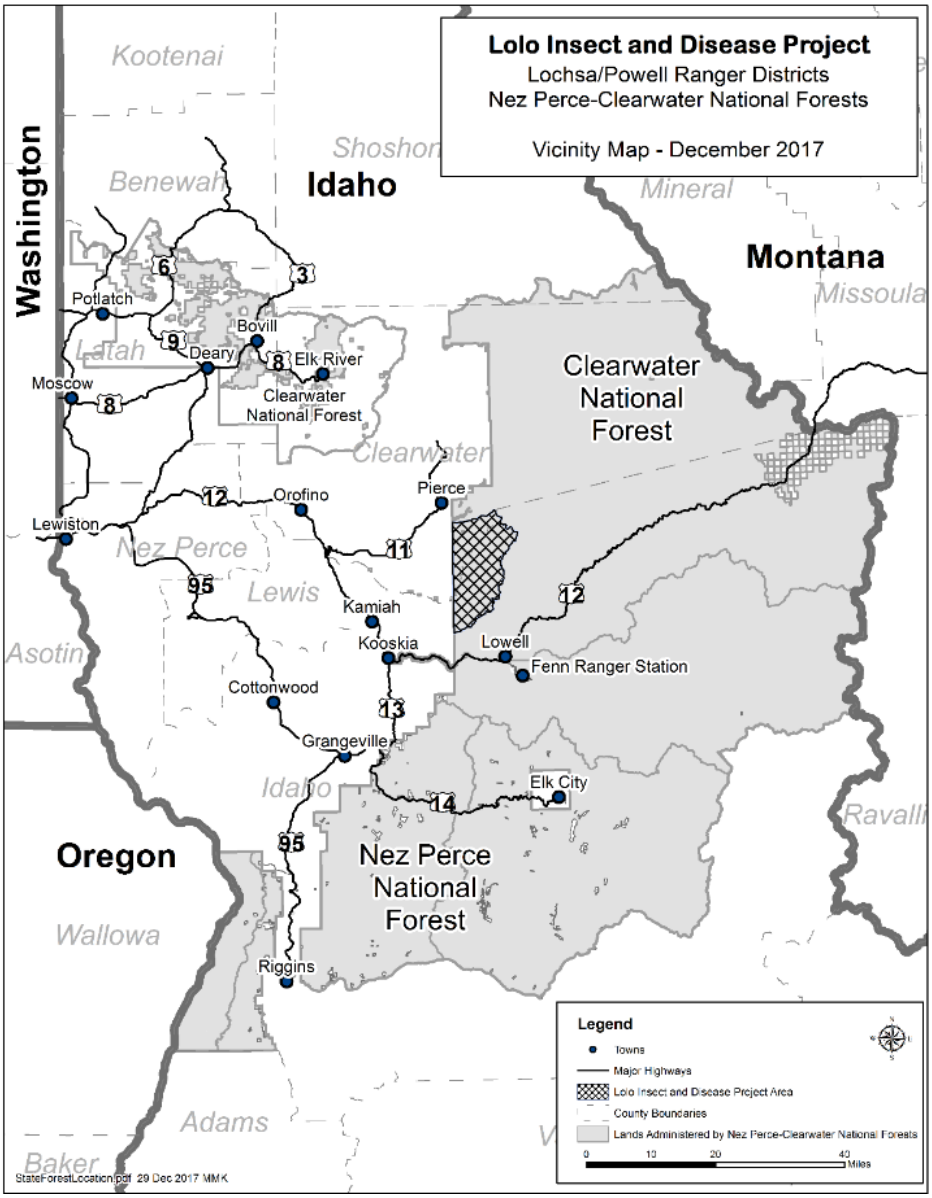
II. Project Area

Project Area

Project activities occur within the Lolo Creek drainage which lies about 16 miles northeast of Kamiah, Idaho in portions of Townships T33N, T34N, T35N, and T36N, Ranges R5E, R6E and R7E, Boise Principle Meridian (Figure 1). The Lolo Creek drainage is 157,000 acres in size and flows into the Clearwater River near Greer, Idaho. The Forest manages 78,500 acres, Idaho Dept. of Lands (19,000 acres) and the Bureau of Land Management (5,000 acres). The remaining is held in private ownership (54,000 acres). The majority of land in the drainage is managed for timber production while about 11,000 acres is managed for agriculture or residential areas.

The majority of activities associated with the Lolo Insect and Disease Project Area occur within the Forest Service (FS) managed lands. Forest Road 100 where it crosses State and private lands is the only area outside of FS lands that would be used for the project. This is the primary road used for public and administrative access, as well as log haul and is maintained by Idaho County where it leaves National Forest lands near Yakus Creek.

Figure 1. Vicinity map of the Lolo Insect and Disease project area



Action Area

The action area includes all watersheds or partial watersheds that may be directly or indirectly affected by the proposed action. It includes watersheds where project activities will occur including harvest, haul, project-related road work, planting, brush disposal, water pumping, refueling, and equipment servicing. This includes the mainstem of Musselshell Creek and its tributaries (Gold, Alder, Dewey Creek, Cole Creek, and Weaver Creek from its headwaters to 600' below the Forest Boundary), upper Lolo Creek and its tributaries (Belle and Dutchman), Yoosa and its tributaries (Chamook, Mox, Relaskop, Camp, and Tray Creeks), the mainstem of Eldorado Creek and its tributaries (Cedar, May, Six-bit, Dollar, Two-bit, Lunch, Trout, Fan and Snow Creeks), Yakus Creek from the headwaters to Forest Road 100, Molly Creek, and Mud Creek. The action area also includes the 20 mile section of county maintained Forest Road 100 from the Forest boundary to Kamiah, Idaho.

The action area has designated critical habitat for Snake River Basin steelhead and is used by Snake River Basin steelhead for spawning, rearing, and migration. Steelhead critical habitat is designated in Lolo, Musselshell, Camp, Yoosa, Eldorado, Cedar and Mud Creeks (Map 1, Appendix A). The action area also includes EFH for Chinook and coho salmon (Map 2, Appendix A). Bull trout spawning and rearing has not been documented in the Lolo Creek drainage; however individual bull trout have been caught in mainstem Lolo Creek during fish trapping efforts. Bull trout that have been caught in the mainstem and are considered to be foraging sub-adults and adults. There is no designated critical habitat for bull trout in the Lolo Creek drainage.

III. Description of Proposed Action

The following describes the proposed activities and the design features and BMPs associated with each activity. A more detailed list of design features and BMPs can be found in Appendix C of this document.

Harvest

The Project proposes to salvage harvest 3,383 acres using three methods (Map 3, Appendix A). Harvest units with hillslopes less than 35% gradient will be yarded using ground-based skidding (54% of harvest) and slopes greater than 35% will be yarded using skyline cables (35%) or helicopters (11%). Landslide prone areas would be buffered. Harvest and yarding/skidding would not occur on these areas. Regeneration harvest (clearcut with reserves or shelterwood) would be conducted on 2,640 acres (Table 2). Intermediate harvest (commercial thinning) would occur on 743 acres outside of PACFISH RHCAs.

Table 2. Acres of harvest by prescription for Alternative 5 within project area HUC12 subwatersheds.

Prescription	**Upper Lolo**	**Musselshell**	**Middle Lolo**	**Eldorado**
Regeneration Harvest	997	657	85	902
Intermediate Harvest	286	456	0	0
Total Harvest Acres	1283	1113	85	902
Total Watershed Acres	26,845 (all FS)	14,835 (FS) 20,490 (Other)	9,725 (FS) 19,745 (Other)	27,176 (all FS)
Percent of Watershed Harvested	4.8%	3.2%	0.3%	3.3%

FS- Forest Service; Other- State, private

The Forest will mark harvest unit boundaries during layout and will identify trees to be retained within the units. Reserve trees would consist of 14-28 trees per acres for clearcut units and 14-40 trees per acre for shelterwood harvest units. Trees would be left in both clumps and as individual trees. Intermediate harvest would create small openings within harvest units infected by root rot. The openings would extend up to 50 feet away from the last live infected tree. Planting would occur in all harvest units where openings are created.

PACFISH Riparian Habitat Conservation Areas (RHCAs) would be identified and marked during harvest unit layout. No harvest would occur within 300' of fish bearing, 150' non-fish bearing perennial, or 100' of intermittent streams or field verified landslide prone areas.

To reduce soil disturbance and erosion from yarding activities, best management practices (BMPs) will be followed before, during, and after harvest. Prior to harvest, skid trails, swing trails (2.6 miles), landings, yarding corridors, and slash pile areas will be located outside of RHCAs and would not cross streams. These trails, corridors, and areas will reuse previously disturbed areas, such as remnants of road templates, if possible. Reusing these areas will help to minimize the area of new detrimental soil effects which can result in erosion and sediment delivery to waterways. Swing trails will be constructed on slopes of 20 – 35 percent (relatively gentle but too steep for trucks) for transferring logs from skyline areas to landings for haul. Swing

and skid trails would be managed to minimize disturbance while in use. Swing and skid trails and yarding corridors would be hydrologically disconnected from streams primarily through RHCA retention. Swing and skid trails would be water-barred if overwintering of the trails is necessary. Yarding corridors would maintain some surface slash and other woody material to minimize erosion potential.

A total of 4 helicopter landings would be used, 2 new landings in existing disturbed areas and 2 on existing roads. Landings are approximately ½-acre in size, near ridgetops and may require some minimum amount of clearing and ground work to accommodate a helicopter. Other landings will be needed for skyline and ground-based yarding but will be located on roads or existing landings and may require minimal clearing. Landings (roadside or helicopter) will be located outside of RHCAs with no hydrologic connectivity to streams. In addition, road and trail approaches to landings will be designed to avoid channelized flow from entering the landing areas.

Harvest may occur in all seasons but the majority will take place from June through October. Operating periods will be limited to avoid saturated soils and prevent resource damage (damage indicators include, for instance, excessive rutting, soil displacement, and erosion). Contractors are responsible for damage to harvest areas and roads, and will either self-administer to halt activities and repair any damage that becomes evident or will be shut down until damage is repaired; the NPCNF will regularly inspect active haul roads within 600' of steelhead occupied or designated critical habitat. The inspection emphasis will be for wet days and within 2 days following wet no-haul conditions. For ground-based yarding, trees will be directionally felled along pre-designated yarding patterns to minimize the amount of passes and disturbed area.

Following harvest, areas of new soil disturbance will be stabilized. For all harvest areas, coarse woody debris will be left on site according to Regional Forest guidelines that prescribe 7 – 33 tons per acre. This coarse woody debris retention is to prevent erosion and retain soil productivity. Skid trails will be decompacted and 4-8 tons/ac of slash would be placed on their surfaces. This equates to about 40% coverage of the disturbed surface. Swing trails, new landings, and areas cleared to expand landings, will be obliterated, recontoured, and covered with 4-8 tons/acre of slash after use. Skid trails would be decompacted and stabilized after use unless they are deeply rutted or compacted at which point they would be fully obliterated. All harvest areas will be reforested.

Site Preparation

Burning of slash piles and fuel concentrations within harvest units (broadcast burning) will be used to reduce fuel loading in areas designated for replanting. Slash piles will be located on landings and other areas outside of RHCAs where they will not interfere with natural drainage patterns. Jackpot burning will occur primarily within the tractor logged units and broadcast burning will occur in cable/skyline and helicopter units. No fire ignition will occur within RHCAs, however, fire would be allowed to back into them.

Soil Restoration

Soil restoration is also proposed on approximately 55 acres in the intermediate harvest units where detrimentally disturbed occur as a result of past harvest activities. Activities would include mastication of vegetation followed by decompaction of soils, and addition of woody/organic material. Seeding and fertilizing may also occur. While some of the activities may occur within RHCAs of intermittent streams, no decompaction will occur within 30' of streams in order to avoid streambank destabilization.

Road Preparation

Temporary roads will be built for haul (13.8 total miles with 3.8 miles on existing non-system road templates and 10 miles of new construction) (Maps 4, 4a, 4b, and 4c, Appendix A). When possible,

temporary roads are built on older existing road or skid trail templates thus avoiding undisturbed ground. New temporary roads will mostly be located on or near ridgetops, avoid RHCAs, and be designed to prevent pathways for channelized flow or sediment delivery to the stream network. All temporary roads are planned for obliteration within two operating seasons after use. This would eliminate any future motorized use of the road. Obliteration can include recontouring, decompaction, and the application of wood and/or slash. Techniques are decided on a site by site basis along each temporary road segment.

Two segments of ***permanent road*** will be built for haul (0.74 miles) and will allow for the decommissioning of a stream adjacent road (Map 4a, Appendix A). The roads will be located near the ridgetop outside of RHCAs in the Musselshell subwatershed and will be designed to prevent pathways for channelized flow or sediment delivery to the stream network.

Road preparation consists of reconditioning and reconstruction before haul. It includes up to 157 miles of road reconditioning for haul road safety and to minimize erosion from haul (Map 5, Appendix A). Reconditioning will include blading, brushing/clearing roadside vegetation, the removal of small cutslope failures, cleaning ditches, minor reshaping, surface compaction, and spot surfacing. The project would only remove material where ditches are plugged or not functioning. Long lengths of ditch would not be bladed retaining the thick grass that is currently present and acting as a sediment filter.

Road reconstruction consists of replacing culverts on small perennial streams (see next paragraph), outsloping of roads, adding cross drains, addressing culverts/cross drains that are perched on the floodplain, addressing culverts/crossdrains that directly drain into the creek, and stabilizing eroding sections of road and will occur on portions of 125 miles of road. Annual monitoring (page 14) may also identify corrective actions that would be implemented prior to any haul.

Twenty-one small culverts have been identified for replacement on Roads 103, 535, 5035, 5107, 5150-B and 5152-B (Map 6, Appendix A). All are on non-fish bearing streams and would not exceed 36" diameter. Two replacements are within 600' of occupied steelhead designated critical habitat on Lolo Creek.

Crossdrains will be added, replaced, removed or moved to address sediment delivery directly to a stream. Surveys will be conducted on all haul roads in order to identify locations where additional cross drains are needed. Field review is proposed on 125 miles of road designated for haul route, with an emphasis on field review of haul roads near adult steelhead known presence and designated critical habitat.

Crossdrain and culvert work will be completed prior to other roadwork and haul to minimize the amount of road network draining to stream crossings during road work and haul. There may be specific instances when the distance increases beyond 200 feet given that the ditch does not have excessive energy, and the greater distance is needed so that ditch water drains onto forested land instead of directly into the stream.

Roads 500 and 540 have received road upgrades and crossdrains as part of regular maintenance in 2003 and 2016, respectively. The remaining haul roads receive regular maintenance; however, additional cross drains may be required within 200' of some streams. Because the majority of haul will be done on system roads that are currently maintained to standard, the majority of road preparation is maintenance oriented which does not require work in streams or numerous culvert replacements. For these road preparations, soil disturbance and sediment delivery to streams will be minimized with implementation of BMPs which include but are not limited to: installing crossdrains prior to other road reconditioning and reconstruction, cleaning ditches and catch basins when needed with no undercutting at the toe of cut slopes, avoiding road widening, removing vegetation in a manner that will not interfere with stream shade, and avoiding disposing of excess material in streams.

Culvert replacement and installation BMPs are described below in the discussion on culverts. Implementation monitoring of road reconditioning and reconstruction activities prior to haul would occur. The monitoring will verify that the implementation of proposed activities and BMPs has minimized or eliminated sources of sediment delivery.

Culvert replacements and removals have a variety of BMPs to minimize soil disturbance and sediment to streams. There are 18 culvert replacements on haul routes and 3 on non-haul routes; two are within 600' of occupied steelhead habitat and occur in the Upper Lolo HUC12 (Map 6, Appendix A). All culvert replacements and removals will adhere to the BMPs found in NMFS' Stream Crossing Programmatic biological opinion (NMFS tracking No. 2011/05875) and the BA for the Project. The BMPs for minimizing sediment delivery can be found in Appendix C and include:

- Removing all fill around culverts prior to culvert removal;
- Diverting water around the stream crossing work area where necessary;
- Limiting excavators to work on one road at a time to reduce bare soil area;
- Using sediment control devices in and out of the stream to minimize sediment delivery to, or sediment movement downstream, in the stream;
- Ceasing work in wet conditions when rutting or erosion cannot be controlled;
- Replanting or seeding culvert removal areas
- Stabilizing culvert removal areas; and
- Following culvert removals, recontouring the stream channels and banks to the natural contours of the surrounding area.

Road Decommissioning

There are 41 miles of system and 4.1 miles of non-system roads proposed for decommissioning with an associated 63 culvert removals. About 4.5 miles of road and four culverts are within 600' of steelhead occupied or designated critical habitat (Map 6, Appendix A). Two removals occur within the Upper Lolo HUC12 and two are within the Eldorado HUC12. Roads for decommissioning were selected because they are not needed for future management. The selection was conducted with an emphasis on those roads near streams. An estimated 3 miles of road will be abandoned and the remainder will be recontoured. Abandoned roads are typically near ridgetops with no stream crossings, may be decompacted or will have waterbars and drainage features in place, and be closed after abandonment. Recontouring decommissioned roads can include full recontour, outsloping, partial recontour, and decompaction. During treatments, stream crossings will be stabilized by installation of grade controls and reshaping the crossing to match surrounding channels and streambanks. BMPs for road decommissioning are designed to minimize short- and long-term erosion and sediment delivery from road surfaces, hillslopes, streambanks, and the stream channel. BMPs for minimizing current or future sediment delivery to streams include, but are not limited to:

- limiting excavators to working on only one road at a time to reduce the amount of bare soil area and potential erosion at any one time;
- ceasing work in wet conditions; using sediment control devices when working adjacent to a stream; creating channels that divert water to the forest floor;
- recontouring slopes to match the surrounding area and natural drainage patterns;
- covering bare soil areas with topsoil, duff, clumps of brush and sod, slash, mulch, planted seed, shrubs, or trees; and
- placing permanent erosion control measures within 5 days following earthwork completion.

Road Storage

Roads are placed in storage when they are not needed for current management (within 10 years) but are needed for future management. Stream crossings are removed and the remaining road prism placed in a hydrologically stable, well drained condition so that no maintenance is necessary until the road is needed. BMPs where culverts are removed are the same as those stated above for culvert removals. Roads placed in long-term storage will be blocked from motorized access. There are 5.4 miles of system roads proposed for storage with an associated 24 culvert removals (Map 6, Appendix A). About 0.2 miles are within 600' of steelhead critical habitat. There are no stream crossings on these roads within that distance.

Dust Abatement

Dust abatement will be applied to haul routes in any year the road is used for haul. Dust abatement is applied to minimize visibility effects and sediment delivery to streams. Typically, magnesium chloride is used for dust abatement on graveled haul routes where harvest volumes exceed 1million board feet (Roads 103, 535, 520, 500, 519, others). When applied to the road surface, a 1-foot no-spray buffer is left on the edges of the road, if road width allows, to minimize overspray into ditches which could contaminate streams. Because the application of magnesium chloride is expensive and water is effective for dust abatement for short durations, haul routes that will be used for short durations with less traffic may receive water for dust abatement. These include most of the 50 miles of native surfaced roads. Pumping water from streams for dust abatement will follow procedures for pumping locations and procedures as described in the Water Pumping section below.

Haul

There will be 43.8 MMBF of logs hauled from the Project area over an approximate five to ten-year period. Timber sale contracts would be awarded within the first five years but actual harvest and haul could take as little as five years or as long as ten years. For the purposes of this analysis, 5 years is considered as it is the minimum, and most concentrated amount of time over which haul could occur. As harvest is completed, the portions of those roads would no longer be used for log haul until such time that another sale is planned. Other activities such as recreation and administrative access would continue where roads are open to use.

There are several primary haul routes that will be used for the project. The amount of haul, titled as "Maximum Estimated No. Trips", "Loads per day" and estimated and "Assumed time period of use (years)" are displayed in Table 3 and Haul locations are displayed on Map 5 in Appendix A. The maximum number of trips shown in the table are expected to be overestimates as a result of on-the-ground unit layout which typically results in 20 to 35% fewer acres being harvested. The reduction is primarily due to the PACFISH RHCA retention. All log loads will exit via Road 100 which is paved in its entirety and lies adjacent to Lolo Creek along 7 of its 8-mile length on Forest lands. The remaining 20 miles are on State or private lands and are also paved. Log haul would occur during dry or frozen conditions with most occurring between the months of June and September.

Table 3. Primary haul roads and their associated haul information for Alternative 5.

Haul Road # (HUC 12)	Miles of Haul on Road	MM Board Feet Hauled	% of Total Harvest	Maximum Estimated No. of Trips	Loads Per Day (Jun-Sept)	Assumed Time Period of Use (Years)
100 (Musselshell) (Upper Lolo)	**28** (1) (4)	43.8	100	8890	25	5

Haul Road # (HUC 12)	Miles of Haul on Road	MM Board Feet Hauled	% of Total Harvest	Maximum Estimated No. of Trips	Loads Per Day (Jun-Sept)	Assumed Time Period of Use (Years)
(Middle Lolo) (Lower Lolo on State/Private)	(3) (20)					
103 (Upper Lolo)	**11.6**	7	14	1420	6	3
535 (Musselshell) (Upper Lolo)	**12.4** (5.7) (6.7)	14	28	2840	12	3
540 (Musselshell)	4.7	3	5	610	4	2
500 (Eldorado)	12.9	11	23	2230	10	5
520 (Upper Lolo) (Eldorado)	**10.2** (3) (7.2)	6.8	13	1380	12	3
519 (Middle Lolo)	3.2	5	10	1000	4	3
5150 (Musselshell)	3.3	7	14	1400	7	1

There are a total of 75 miles of haul roads *within RHCAs (full extent, inclusive of the first 600 feet, which is twice the PACFISH RHCA buffer for project effects and avoidance)* with an associated 271 perennial stream crossings in the Lolo Creek drainage (Table 4). There are 4 additional crossings on Forest Road 100 on State/private lands outside of the drainage of which two are potentially fish bearing but carry very low flows during the summer.

Table 4. Haul road miles by surface type within RHCAs and stream crossings.

Haul Road Miles within PACFISH Buffers of All Streams by Surface Type				***Total Miles of Haul Road within RHCAs***	*Total Number of Stream Crossings*
	Asphalt Miles	Gravel Miles	Native Miles		
Fish Bearing State/Private	6 2	45 0	3 0	**54** **2**	45 3
Non-Fish Bearing	1	16	2	**19**	223
Total	**9**	**61**	**5**	**75**	**271**

Haul Roads and Crossings within 600' of Steelhead Occupied or Critical Habitat

Haul roads and crossings within 600 feet of occupied or critical habitat are described below. To date, Forest culvert replacement monitoring has not detected turbidity greater than 600 feet downstream of the activity. These findings related to turbidity are consistent with other reported findings in the western United States when culverts are replaced during summer low flow conditions. The following summarizes the totals while Table 5 and Map 7, Appendix A describe and show these in more detail:

- There are 41 miles of haul road within 600' of occupied and/or CH
  - 7 miles are paved, 32 miles graveled and 1 mile native surfaced
- There are 25 fish bearing stream crossings within 600' of occupied and/or CH
  - 8 are paved and 18 are graveled
- There are 60 non-fish bearing stream crossings within 600' of occupied and/or CH
  - 13 are paved, 45 graveled, and 2 native surfaced

A total of 17 of the fish bearing crossings (all culverts or bridges) cross over steelhead occupied or critical habitat, of which 4 are paved and 13 are graveled. There are no low water crossings on federal lands within the watershed.

Each of the 65 crossings on graveled or native surfaced roads collect drainage from 0.1 miles of the Project haul roads. A total of 6.5 miles of road is potentially draining into project area streams.

Table 5. Haul road stream crossings and miles of road adjacent to streams that are less than 600 feet from steelhead occupied or critical habitat.

FS Road No.	Road Surface Type	Road Miles Within 600 feet of:		Culverts		Duration of Haul	HUC12
		Steelhead presence	***Critical Habitat***	***Fish Bearing***	***Non-Fish Bearing***		
100	Paved	7 *0*	7 *4*	7 *3*	13 *4*	5 years	Musselshell Upper Lolo Middle Lolo *State/ Private*
5150	Gravel	0.1	0.1	1	0	1 year	Upper Lolo
103	Gravel	11.5	11.5	3	15	3 years	Upper Lolo
528	Gravel	0.1	0	1	0	1 year	
500	Gravel	1	10	6	20	5 years	Eldorado
535	Gravel	4	2.6	2	5	3 years	Musselshell
540	Gravel	3.3	2.5	2	3	2 years	
505	Native	0.5	0.5	-	2	2 years	
5156	Gravel	0.2	0.2	1	0	2 years	
520	Gravel	0.5	2.5	2	2	3 years	Upper Lolo, Eldorado
Total		**28.2**	**40.9**	**28**	**64**		

Most of the 185 miles of haul roads are existing Forest roads which receive regular use and maintenance. Approximately 8.5 miles are paved and 126 miles are fully graveled and have well vegetated ditchlines. There are 50 miles of native surfaced haul roads, most of which occur near ridgetops with no or only limited stream crossings. Sixteen of the 50 miles are open seasonally and the remaining 34 are closed to motorized use. To minimize sediment delivery from haul roads, cross drains will be in place on either side of crossings where needed, which will minimize road area drainage to stream crossings.

Haul road inspections and maintenance will increase during haul. Inspections of temporary roads will be used to verify that erosion and storm water controls are implemented and functioning properly. Active haul roads within 600' of steelhead presence will be inspected by the Sales Administrator during haul to ensure erosion is not occurring in an amount and location that would result in sediment delivery to streams (generally, inspections of sale operations occur weekly, more often during times with higher potential for impacts to resources). Haul roads not in these areas will be inspected but at a lower rate. For roads greater than 600 feet away from occupied steelhead habitat or critical habitat, the contractors or the Sales Administrator will decide whether to cease haul during wet periods when haul trucks create ruts greater than three inches deep for 50 feet.

Following the wet periods when haul is interrupted, all active haul roads will be inspected for signs of potential environmental damage (PED) within 2 working days of roads becoming drivable and before haul

resumes. Signs of PED are those with the potential to deliver sediment and are of a scale that requires repair by mechanical equipment. PEDs include, but are not limited to, sediment delivery to a perennial stream, excessive ditch scour, or ditch or culvert blockage. Within the 2 working days of inspection, contractor will be directed to correct the cause of the PED condition within 4 days following notification. A log that identifies all PEDs and documents NPCNF and contractor compliance during the corrective 4-day time frame will be kept.

BMPs for minimizing channelized flow and sediment delivery during winter are the same as for wet weather with additional BMPs for snow. Winter haul BMPs include leaving approximately two inches of snow on road surfaces, not hauling under wet conditions, not side casting into streams, and breaching snow berms as necessary to avoid concentrating flow on the road surface.

The action also includes BMPs to reduce risk of accidents and fuel spill from haul. To limit the risk of potential accidents and consequent fuel spills, roadside signs will be posted warning the public and truck drivers of the driving hazards, speed limits will generally be limited to 25 miles per hour or less, and dust abatement will be employed to increase visibility.

Water Pumping

Pumping water from streams to tanker trucks may be necessary for dust abatement and possibly for containment of fire associated with site preparation burning. Water used for dust suppression on haul roads will be pumped from previously used sites on Lolo, Yoosa, Musselshell, and Eldorado Creeks. These sites have been used in the past for dust abatement and fire suppression. If a new pumping location is necessary, the location would be approved by a NPCNF fisheries biologist or hydrologist. Proposed BMPs to minimize impacts to fish from pumping include maintaining fish passage, pumping no more than 20 percent of streamflow, and not exposing undercut banks. Pumping will follow NMFS pumping criteria and screening criteria (NMFS 2011) to isolate the area around the pump intake so fish will not be entrained in the pump or impinged on the intake screen. Through necessity, pumping from streams is the only activity that allows fuel storage and transfer in RHCAs. To limit the risk of a toxic fuel spill in RHCAs from pumping, fuel containers for the pumps will not exceed 5 gallons (maximum of two containers) and absorbent materials would be available on site. Fuel containers will be stored on trucks, or placed on absorbent mats, during pumping.

Refueling and Equipment Servicing

Fuel storage and refueling will occur at various locations depending on the equipment being refueled. No refueling or fuel storage will occur within RHCAs, with the exception of pumping water as described above.

For helicopter refueling, there are two proposed service landings. Both are near ridgetops adjacent to or near Road 535 (Map 4a and 4b, Appendix A). Helicopters are refueled every 1 – 1.5 hours through a secure system with a very low risk of spill. Fuel is stored in trucks with an 8000-gallon capacity. Because total storage will exceed 1,320 gallons, the contractor is subject to the rules and provisions of Federal Regulation 40 CFR 112 and must submit to the NPCNF a Spill Prevention, Control, and Countermeasure Plan (SPCC).

Other than helicopter fuel, fuel storage in the Project area for logging operations typically will not exceed 1,000 gallons. For any amount over 200 gallons, containment is required. It is standard practice for loggers to refuel all equipment using 40- to 75-gallon slip tanks stored in the back of pickup trucks. Chainsaws are refueled from 5-gallon containers that may be taken into the field. Logging trucks will refuel in town, outside the Project area. All on-site fuel storage, fuel transfer, and machinery servicing is governed by the provisions of the sanitation and servicing portion of the timber contract. The timber contract provisions include, for instance, that contractors will maintain all equipment in good repair and free of abnormal leakage of

lubricants, fuel, coolants, and hydraulic fluid. Also, for stationary equipment such as yarders, contractors will be required to have absorbent pads under the machines.

Non-Harvest or Aquatic Restoration Activity: New OHV Trail Construction

A 300' long OHV trail would be constructed in order to create a loop opportunity from Trail 5010 to Trail 5550. The trail crosses no water and would be designed with appropriate drainage to reduce or eliminate erosion potential on the surface of the trail. BMPs would be used during construction to limit disturbance outside of the trail tread.

Monitoring

Monitoring and inspections of haul road preparation, road conditions during haul and after wet weather, and harvest areas will be continuous throughout implementation of the Project. Specific and more regular inspections will occur on Roads 103, 535, 500, 520, and 540. Haul inspections would occur regularly while active haul is occurring.

PACFISH RHCA monitoring would be conducted annually by the Forest Fisheries Biologist in conjunction with BMP audits. Monitoring would be conducted on randomly selected treatment units throughout the Forest and results would be reported in the Nez Perce-Clearwater Forest Annual Monitoring and Evaluation Report. Both implementation and effectiveness of treatments would be monitored. Treatments within the project area may be selected for monitoring.

The Forest Service and National Marine Fisheries Service will initially conduct calibration field reviews which would include road work planning and of completed road work. The purpose of the calibration field reviews are to jointly identify and understand expectations and limitations for road work necessary to minimize sediment delivery. These reviews are intended to only be needed in the initial stages of this project and may not be needed as expectations become clearer for both parties. The Forest would also provide annual progress reports of changes to the road network and drainage system to the National Marine Fisheries Service no later than December 1st of each calendar year.

Timeframe for Actions

The proposed activities would be implemented beginning in 2019 and completed by 2029. Road reconstruction work would be conducted prior to log hauling activities in order to conform to Best Management Practices (BMPs). Road decommissioning would occur concurrent with or after timber harvest activities as some of the roads are needed to conduct the harvest. The majority of work discussed in this section will be carried out by sale contractors and overseen by Forest Service contract administrators to ensure BMPs are implemented.

IV. Description of the Project Area, Species and Habitat

Project Area Overview

There are five HUC12 subwatersheds (Lower, Middle, and Upper Lolo, Eldorado and Musselshell Creeks) within the drainage (Map 1, Appendix A). All of Eldorado and Upper Lolo are managed by the Forest

Service as well as portions of Musselshell and Middle Lolo watersheds. There are no Forest managed lands in the Lower Lolo watershed.

Elevations in the drainage range from 1,100 feet at the mouth of Lolo Creek to 5,200 feet in the headwaters. Mean discharge at the mouth is 100 cfs. Flows range from a low of 60 cfs in August to a high of 825 cfs in April. The Lolo Creek mainstem is approximately 42 miles long. In the 24-mile stretch from the mouth to the Forest boundary, Lolo Creek flows through a steep, V-shaped canyon which is 1,500 feet deep in the lower portion of this stretch and approximately half this depth at the Forest boundary. The watershed above the canyon is comprised of open meadows interspersed with gently sloping, mostly forested upland.

The majority (86%) of Forest managed lands are comprised of gently rolling hills, 9% are transition zones between steep landforms and rolling hills, 3% are uplands, and 2% stream terraces. Soils are deep and covered in a layer of Mazama ash which makes them very productive and resistant to hillslope erosion. Hillslopes are mostly stable with about 2% of Forest lands exhibiting a high or very high mass wasting potential. State and private lands in the Musselshell drainage and along the upper elevations of the canyon section are forested areas with gently rolling hills and contain a smaller portion of pasture or meadowlands.

The wildfire regime is typified by small wildfires (<10 acres) that cause only localized tree mortality. Larger and more severe stand replacement fires range between 150 and 300 years. Recent moderate and high severity fire occurred in the drainage in 2015 where 5,700 acres burned in the upper drainage on FS lands and 14,000 acres burned in the lower canyon on State/private lands. About 1,500 acres of harvest of burned timber on State and private lands occurred in 2015 and 2016.

There is one Idaho Roadless area (6,800 acres Eldorado Creek) and one Research Natural Area (400 acre Fourbit RNA) on Forest lands in Lolo Creek. Together they comprise 9% of Forest managed lands in Lolo Creek. No harvest is proposed in either area.

There is a natural bedrock falls on Eldorado Creek one mile up from its mouth which limits upstream fish access into the drainage. It is thought to be a total barrier to Chinook salmon and resident fish and a partial barrier to adult steelhead trout.

Typical stream temperature patterns show a steady rise in late June and early July as the snowmelt runoff declines, a peak in mid to late July, and then a decrease in late August as nights become longer and cooler. In most years, temperatures drop off significantly beginning in October. Jim Brown, Eldorado, and Musselshell Creeks are considered impaired and are listed based on stream temperature IDEQ (2011). A TMDL has been written for these streams and was approved by EPA (IDEQ, 2011).

There are 2,650 acres of modeled potential landslide prone areas on FS lands. Roughly 880 acres (33%) occur within RHCAs. Overall Lolo Creek has a low occurrence of landslides due to gentle topography, and deeps soils which promote dense vegetation. Only 12 landslides were noted after the 1995/1996 flood events (McClelland et al, 1997). Eight of these were road related, 3 were harvest related and 1 was naturally occurring. Five of the road-related landslides occurred on roads proposed for decommissioning with this project (FS Road 100-D, Road 5119). The older harvest related slides appear to have occurred on landslide prone areas. Harvesting in that era did not prohibit activities on landslide prone areas. Proposed activities in this project would not harvest on field verified landslide prone areas.

Regeneration timber harvest has occurred on 30% of FS lands and a large portion of State/private lands since the 1940s.Commercial thinning has been conducted on about 40% of FS lands mostly since the 1960s. Streamside buffers were retained in the 1980s and early 1990s but were generally no larger than 50’ wide. Harvest in PACFISH RHCAs has not occurred since 1995.

Forest Service lands are managed primarily for timber harvest; however, dispersed camping, OHV use, hunting and berry or mushroom gathering also occur in these areas. Almost all State and private lands have, or continue to experience timber harvest and grazing.

There are three grazing allotments on Forest managed lands totaling 31,600 acres which allow use by 200 cow/calf pairs. The area is considered transitory range due to the predominance of forested areas. Cattle graze primarily along roads and within recent timber harvest units. Two of the largest meadow areas (Musselshell and Deer Gulch) and some streamside areas have been fenced to exclude grazing in order to protect important fish spawning reaches and also camas collection areas for Nez Perce tribal members. Cattle access to streamside areas is generally limited due to thick riparian vegetation and mostly unpalatable plant species. Grazing also occurs on private lands, primarily in the Musselshell watershed where meadow habitats are more available and pastures have been maintained.

Status, Trend and Distribution of ESA-Listed Species

The U.S. Fish and Wildlife Service (USFWS) species list accessed on February 28, 2018 (https://ecos.fws.gov/ipac/) identified bull trout as the only threatened resident fish species under ESA within the project area. The NOAA Fisheries list was accessed on the same date which identified Snake River steelhead trout and fall Chinook salmon as threatened under ESA and the only other listed fish species in the project area (http://www.nmfs.noaa.gov/pr/species/esa/listed.htm#fish). Only the species which potentially could be affected by the project will be analyzed in detail in this document (Table 6).
In addition, the Lolo Creek watershed is designated as Essential Fish Habitat for Chinook and coho salmon under the Magnuson-Stevens Act. Federal agencies must consult with NOAA Fisheries regarding any of their actions that may adversely affect EFH. This document includes an assessment of the effects of the Lolo Insect and Disease Project on EFH in Lolo Creek.

Table 6: Summary of ESA-listed species presence in Lolo Creek.

Species	Rationale
Columbia River Bull Trout Designated Critical Habitat	Species present in the project area No critical habitat in the Lolo Creek watershed
Snake River Steelhead Trout Designated Critical Habitat	Species is present in the project area Critical habitat is present in Lolo Creek and in the project area
Snake River Fall Chinook Salmon Designated Critical Habitat	Neither present within the Lolo Creek watershed
Snake River Spring/Summer Chinook Salmon Designated Critical Habitat	Neither listed in the Clearwater River drainage
Sockeye Salmon	Species does not occur Clearwater River drainage
Essential Fish Habitat: Chinook and Coho Salmon	Essential fish habitat is present in Lolo Creek and the project area

Steelhead Trout

"The ESU/DPS-level viability criterion focuses on ensuring the preservation of basic historical metapopulation processes needed to maintain a viable ESU or DPS in the face of long-term ecological and evolutionary processes. These characteristics include (1) genetic exchange across populations within an ESU/DPS over a long time frame; (2) the opportunity for neighboring populations to serve as source areas in the event of local population extirpations; and (3) populations distributed within an ESU/DPS so that they are not all susceptible to a specific localized catastrophic event." (NOAA, 2017)

Snake River steelhead trout are currently listed as Threatened under the ESA. The steelhead trout population in Lolo Creek is one of five populations included in the Clearwater River Major Population Group (MPG) (NOAA 2017). The NOAA recovery plan (2017) identified the population rated as "maintained, or tentatively at high risk" due in part to uncertainties regarding natural productivity in the watershed, hatchery spawner composition, a lack of population monitoring information and habitat limiting factors including temperature, habitat complexity, sediment, passage barriers and riparian condition. For steelhead to reach recovery in the Clearwater MPG, the Lolo population needs to be "maintained" long term at a basic level of 500 returning adult steelhead.

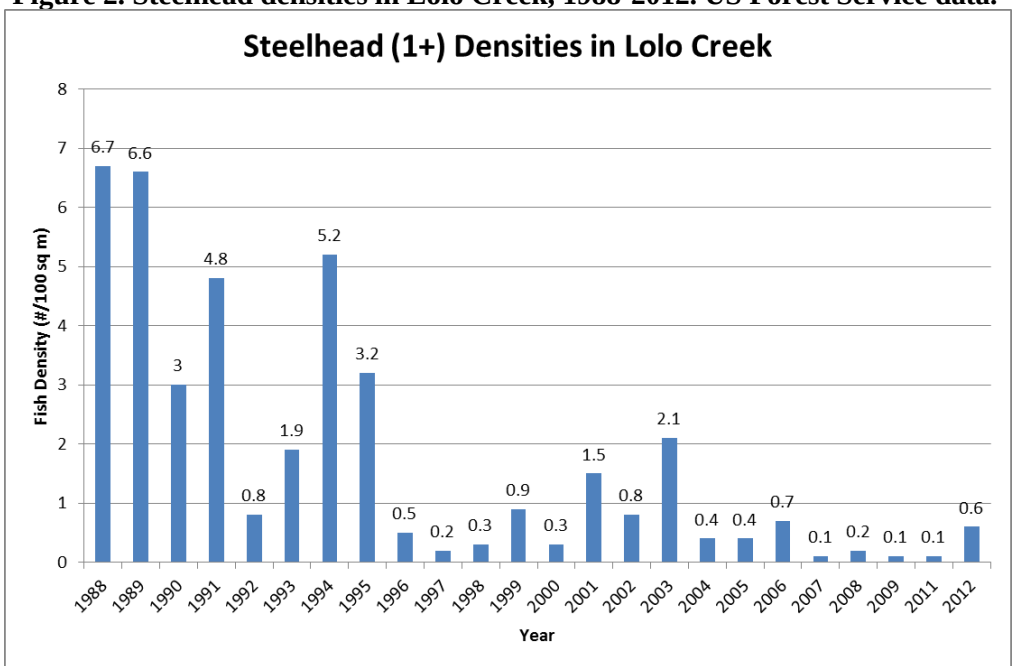
Critical habitat was designated for steelhead in Lolo, Yakus, Yoosa, Camp, Eldorado, Cedar, Musselshell, and Jim Brown Creeks (Map 1, Appendix A). There are 50 miles of designated critical habitat for steelhead on Forest Service managed lands in the drainage; however roughly 12 miles of this occurs above Eldorado Falls and is only occasionally accessible to steelhead.

Steelhead have been found in 58 miles of stream on FS lands indicating spawning and rearing habitat exists outside of designated critical habitat in Lolo Creek (Map 1, Appendix A). The presence of steelhead trout in Lolo Creek is a result of both wild and hatchery production. Hatchery out-planting of both adult and juveniles has occurred over the past 25 years. Hatchery juveniles continue to be released annually.

Juvenile fish population surveys by the Forest Service, BLM, and Nez Perce Tribe over the past 20 years have documented juvenile steelhead trout along most of the mainstem of Lolo Creek. A summary of the available fish population data shows that between 1985 and 2007, steelhead were observed on average at of 81% of the sampling stations. The probability of finding them in the mainstem of Eldorado (below the falls) was 80% and above the falls was 30%. The probability of finding them in the mainstem of Musselshell Creek was 11% and in the mainstem of Yoosa Creek was 83%. The probability of finding them in the smaller tributaries of these streams averaged 15%.

Average densities of steelhead trout (age 1+) were documented at permanent sampling stations on the mainstem of Lolo Creek between 1988 and 2012 (Figure 2). Steelhead trout populations have shown a decline since 1988 even though riparian habitat has been protected since 1995, new specified road construction has rarely occurred anywhere in the watershed since 1999 when a temporary road moratorium was passed, a succession of other road restriction policies since then. The Forest Service has also taken action to improve habitat through road decommissioning and restoration activities such as the Collete Mine Restoration Project. Fish densities went from a high of 6.7 fish/100m^2 in 1988 to a low of 0.1 fish/100m^2 in 2007, 2009 and 2011. Snorkel surveys conducted in 2017 by Idaho Fish and Game found densities ranging from 0 to 7 fish/100m^2. None were found on the mainstem of Lolo Creek on FS lands between Yakus and Yoosa Creeks but were found in Lolo above Yoosa. Densities in Eldorado were <1.5 fish/100m^2. The highest densities (7 fish/100m^2) were found in Yakus Creek. Populations are persistent but densities are overall considered low throughout the drainage. Reasons for the decline are uncertain. Declines are considered to be affected by poor ocean conditions and survival, in-river migration challenges outside the project area, low adult returns, and less than optimum habitat conditions. Fitness may also be an issue. Populations follow the same trend as that seen in the Snake River basin (Good, et al. 2005).

Figure 2. Steelhead densities in Lolo Creek, 1988-2012. US Forest Service data.



The highest quality and quantity of steelhead trout spawning habitat occurs in designated critical habitat on the mainstem of Lolo Creek between Musselshell and Yoosa Creeks. A total of 88 redds were observed on the mainstem of Lolo Creek during surveys in 1987 (Clearwater Biostudies Inc., 1988). About 66% of them occurred in the 6-mile-long section of Lolo Creek above the confluence with Musselshell Creek and 30% occurred between the Forest boundary and Eldorado Creek (Map 1a, Appendix A). Spawning on Forest Service lands in Musselshell Creek is limited due to small sized gravel which is mostly unsuitable for spawning. Stream habitat surveys in Eldorado Creek also indicate minimal amounts of spawning habitat and when combined with Eldorado Falls, their distribution is limited in the drainage. Only isolated pockets of spawning habitat are available in Camp, Yoosa, and the upper most 5 miles of Lolo Creek due to smaller stream and substrate sizes and higher stream gradients.

Columbia River Bull Trout

Bull trout are present throughout the Clearwater basin which are included in the Columbia River bull trout Distinct Population Segment (DPS). This DPS was listed as threatened under the Endangered Species Act in 1998 (Federal Register Vol. 63 No. 31647).

A total of 19 bull trout were observed on the mainstem of Lolo Creek between 1987 and 2007 during various survey and trapping efforts by the USFWS, BLM, IDFG and Nez Perce Tribe. No bull trout were observed by Forest personal during summer snorkel surveys at 20 long-term permanent monitoring stations on Lolo Creek. No bull trout have been observed in any tributary to Lolo Creek and no redds have been documented through any of the monitoring efforts. No specific surveys for bull trout redds have been conducted in the

drainage. In 2015, environmental DNA (eDNA) sampling was conducted in Upper Lolo, Belle, Yoosa, and Musselshell Creeks (Map 10, Appendix A). Bull trout DNA was detected only in the mainstem of upper Lolo Creek above Belle Creek. This form of sampling cannot indicate population size or density but only indicates if fish may be present in the stream. While possible, it is extremely unlikely that an isolated population of resident bull trout exist in this area. Sub-adult and adult bull trout are known to solitarily travel long distances to forage when not spawning. The eDNA detection is highly likely to have occurred based on the foraging of one or a few individuals (Young, M, personal communication).

Critical habitat for bull trout was designated on October 10, 2010. There is no designated critical habitat for bull trout in the drainage resulting from naturally warmer than preferred temperatures during the adult migration and spawning period, and the juvenile rearing period.

Snake River Fall Chinook Salmon

Fall chinook salmon are not known to occur in the project area or Lolo Creek drainage. They are known to occur and spawn downstream of Lolo Creek in the mainstem Clearwater River. Critical habitat was designated for fall Chinook on the mainstem Clearwater River. No critical habitat occurs in Lolo Creek.

Snake River Spring/Summer Chinook Salmon

Snake River spring/summer Chinook salmon are not listed under ESA in the Clearwater River basin; however, available information shows they occur within the Lolo Creek drainage, primarily on the mainstem of Lolo Creek and the lower mile of Eldorado Creek.

Snake River Sockeye Salmon

Snake River sockeye salmon and their designated critical habitat do not occur in the Clearwater Basin.

Essential Fish Habitat

Essential Fish Habitat (EFH) is designated for chinook and coho salmon in Lolo Creek and throughout the Clearwater subbasin. The watershed supports both spawning and rearing and is considered Essential Fish Habitat (EFH) by NOAA.

There are about 17 miles of spring chinook/coho salmon habitat on Forest managed lands in Lolo Creek (Map 2, Appendix A). Redd locations shown on the map coincide directly with available salmon habitat. The majority of habitat occurs on 7 miles of the mainstem of Lolo between Musselshell and Yoosa Creeks. One mile occurs on the lower mile of Eldorado Creek and there are about 2.5 miles of low quality spawning habitat on Musselshell Creek. Chinook salmon are a Forest Service sensitive species and an important cultural resource for the Nez Perce Tribe. Adult coho have been occasionally planted by the Nez Perce Tribe in Lolo Creek; however, a self-sustaining run has not yet developed.

The current population of Chinook salmon varies within Lolo Creek as a result of natural spawning combined with supplementation efforts by the Nez Perce Tribe. The Tribe collects adult chinook from Lolo Creek and incorporates them into their hatchery program. Eggs are taken, fertilized, and incubated offsite and juveniles are eventually placed into the Tribes acclimation facility at Yoosa Creek. Juveniles are allowed to leave the facility on their own and then will migrate down through the drainage. Spawning data collected by the Tribe between 1988 and 2012 showed a low of 10 redds in 1995 to a high of 500 redds in 2001. Recent Chinook redd surveys by the Nez Perce Tribe show highly variable numbers (Table 7). An average of about 90 redds have been documented since 2002. The mainstem of Lolo Creek will continue to provide the majority of spawning and rearing habitat for Chinook salmon in the watershed.

Table 7. Nez Perce Tribe Chinook redd counts in Lolo Creek, 2002 to 2012.

Year	Total Redd Count	Upper Lolo	Musselshell	Middle Lolo	Eldorado
2002	206	175	4	25	2
2003	156	130	0	26	0
2004	45	25	0	16	4
2005	45	23	0	22	0
2006	9	7	0	2	0
2007	14	11	0	3	0
2008	100	71	5	24	0
2009	48	26	0	22	0
2010	46	35	0	11	0
2011	139	123	0	16	0
2012	205	169	6	29	1

Existing Habitat Conditions

Extensive habitat and fish surveys were conducted through contracts in the 1990s (Clearwater Biostudies, Inc. and Isabella Wildlife Works). Much of the following information discussed below is taken from those surveys. Other information used was taken from Forest GIS layers, survey and monitoring data, field surveys, and PIBO data. Very little information from State or private lands was available; however, Google Earth was used to assess some of the watershed conditions. Appendix B contains the NMFS Matrix of Pathways and Indicators tables (i.e. "Matrix") (NMFS, 1998) which summarizes much of the information included below.

Past harvest and associated road construction and grazing have had the most impact on water resources resulting in channel changes, some increases in water yield, and increased sediment yield over natural processes. The past activities are accounted for in the baseline conditions where appropriate.

There is about 750 miles of stream in the Lolo drainage. A minimum of 520 miles occur on Forest managed lands and 225 miles are on State/private lands. Surveys on Forest show that about 27% (140 miles) are fish-bearing. These occur in the mainstems and lower reaches of the tributaries where stream gradients are relatively low (<6%) and suitable habitat for fish spawning and rearing is present. An estimated 70 fish bearing miles occur on State/private lands.

Streams on Forest are dominated by moderate gradients (4-10%) except on the lower mainstem channels of Lolo, Musselshell, Cedar and Eldorado Creeks. These streams have gradients ranging from 1% to 3% and are preferred by salmon and steelhead trout for spawning and rearing.

Watershed Condition Indicators

Roads: Road effects to the environment can occur during construction or with subsequent road presence, upkeep, and use (Daigle, 2010). As specified, road construction has been greatly curtailed on the NPC and the size of the specified network has been declining for well over a decade, new specified construction is not considered to be a primary threat. Existing roads are therefore considered to be the current primary

contributor of sediment to streams, particularly those nearest to them (RHCA roads). Road and culvert failure in rare and extreme weather events can also interact with road prisms to deliver large amounts of fine sediment in a single event.

Chronic road sediment delivery can be reduced through road maintenance practices. Road maintenance focused on routing water either through or off road prisms is considered beneficial to water quality (Burroughs 1990; Grace and Clinton 2006; Switalski et al. 2004; Swift and Burns 1999). Foltz (1996) showed that the use of high quality aggregate (gravel) produced 3 to 17 times less sediment than marginal quality aggregate. The basalt aggregate used for Lolo Insect and Disease project roads is considered high quality as it does not easily break down into smaller fines and dust particles. A study by Swift (1984) showed that placement of a 6-inch lift of 1.5-inch minus crushed rock reduced sediment production by 70 percent from the unsurfaced condition over a 5-month period. In 13.3 months, the gravel with established grass at the margins of the traveled way reduced sediment production by over 84 percent compared to 9.5 months when the road was unsurfaced; [cited in Burroughs and King, 1989]. Burroughs and King (1985) also conducted a study using simulated rainfall to generate runoff and sediment yield from forest roads, ditchlines, and fill slopes. The reduction in sediment production by graveling the road was 79% and remained effective for several years. They also found that where dense grass cover was present on the fill slopes of the road, sediment yield was reduced by 99%. The cut and fill slopes and ditchlines of roads within the project area are mostly densely vegetated with grasses and shrubs. These conditions in the project area are expected to reduce the amount of road generated sediment delivered to streams as compared to newly created fill slopes and native road surfaces. All main project haul roads are graveled and routinely maintained in optimum conditions for travel (Map 8, Appendix A).

Adding cross drain culverts near flowing streams diverts ditch water and its associated sediment away from streams. Damian (2003) found that installation of cross drains within 100'-200' of streams reduced sediment delivery by 76%. A number of studies have also shown that roads can affect the volume and distribution of overland flow and alter channel network extent, pattern, and processes (Harr et al., 1975; King and Tennyson, 1984; Montgomery, 1994; Jones and Grant, 1996; Wemple et al., 1996, 2001); [cited in Croke, et al., 2005]. Water control structures, such as ditches with relief culverts, broad based dips, water bars, and turnouts, can be used to drain insloped road surfaces and minimize the travel length of overland flow (Keller and Sherar, 2003); such that, increasing number of cross-drains reduces drainage area that collect water, reduces erosion, and hydrologic connectivity of road segments to streams [cited in Brown, et al., 2013]. Cross drains are in place throughout much of the drainage, and additional cross-drains will be added as needed.

The Forest has taken steps to reduce road related sediment since the early 1990s by treating roads through decommissioning of road segments not needed for future access or management, or surfacing roads with gravel to reduce surface erosion, paving Forest Road 100 adjacent to Lolo Creek, and more recently installing additional cross drain culverts which divert ditchline water away from streams. Culvert failures that could deliver comparatively very large amounts of sediment to streams are a rare occurrence in Lolo Creek.

Over 150 miles of system and non-system road decommissioning has occurred on Forest managed lands in Lolo Creek since 1992. Currently about 558 miles (4.7 mi/sq mi.) remain with an estimated 775 stream crossings. About 161 miles (29%) are within RHCAs (Map 8, Appendix A). Both total miles and % miles in RHCAS are very high amounts in relation to many federally managed watersheds in the western United States. Initial road construction and harvest that occurred between 1940 and the mid 1990's, is thought to be largely responsible for high sedimentation still present in stream channels today. Lag times between sediment inputs and stream response can vary from days to centuries (Lisle et al, 2015) and are largely based on weather events large enough to mobilize stream materials, particularly fine sediment loads, and how the streambed interacts with streamflow and stream channel characteristics (Wohl et al, 2015).

Any sediment added to streams could move from the higher gradient work sites down into the lower gradient reaches where it could be retained for a period of time. Generally the highest quality and quantity fish habitat occurs in these lower gradient areas and any additional fine sediment could result in increased sediment deposition and reduce the quality and or quantity of that habitat. Several studies found that the retention time of any sediment added to the stream is expected to be 1-2 years (Cissel et al, 2013; Luce and Black, 2001; MacDonald, 2005). Local monitoring during a major road decommissioning project was conducted in Badger Creek (Lochsa River drainage) between 2001 and 2011. A total of 71 miles of road were fully re-contoured in the 3,500 acre watershed between 2001 and 2006. A minimum of 120 stream crossings were removed associated with these roads. Pebble count data was collected in the lower mainstem of the creek below the majority of the decommissioning activities. Pebble count data showed annual decreases in percent fine sediment the first 4 years when the majority of activities occurred (Table 8). A spike was noted in 2007, one year after all activities were completed and was likely due to a large rain event that moved stored sediment downstream. By 2011, the percent of fine sediment had dropped well below what it was before the project was implemented. The data suggests that instream retention times of fine sediment (<4mm) from road decommissioning lasts from 1 to <4 years and is dependent on stream flow events. This would be consistent with previously mentioned studies.

Table 8. Badger Creek Pebble Count Data

	Monitoring Year							
	2001 (baseline)	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2011**
Miles of road decommissioned	17.4	13	22	9.3	5	4.3	-	-
% fine sediment <4mm	33%	26%	25%	23%	-	-	28%	13%

There are about 225 miles of road on State/private lands and 3 miles of roads within Idaho Forest Practices Act buffers with an estimated 158 stream crossings. Most occur in the Musselshell drainage with fewer in the area downstream of the Forest boundary in Middle and Lower Lolo Creek subwatersheds. The area below the boundary has very steep hillslopes and rocky outcrops which limit where roads can be built. A review of state/private lands in Google Earth shows that most lands where harvest occurred were heavily roaded or contain old skid trails. The majority of those roads and skid trails are still in place with roads being evident and skid trails showing as overgrown with vegetation.

The watershed and RHCA road information is shown in Table 9. Both total watershed and RHCA road densities are considered to be in a low condition class as defined by the Matrix of Pathways and indicators. Many of these roads are likely contributing sediment to streams on both federal and non-federal lands.

Table 9. Watershed condition indicators by HUC12 subwatershed.

Subwatershed	**Upper Lolo**	**Musselshell**	**Middle Lolo**	**Eldorado**
Watershed Acres	26,845 (all FS)	14,835 (FS) 20,490 (Other)	9,725 (FS) 19,745 (Other)	27,176 (all FS)
Total Miles of System Road	172	120 (FS) 65 (Other)	80 (FS) 70 (Other)	186
Total Road Density (mi/mi^2)	4.1	3.3	3.2	4.4
RHCA Information				
RHCA Acres	7,740	4,140	2,690	7,235
RHCA Road Miles	49	37	25	50

State/Pvt Riparian Miles[1]	0	2	1	0
RHCA Road Density	4.0 mi/mi^2	5.7 mi/mi^2	5.9 mi/mi^2	4.4 mi/mi^2
Stream Crossings	279	160 (FS only) 100 (State/pvt)	119 (FS only) 58 (State/pvt)	217

[1] Estimated roads within Idaho Forest Practice Act streamside buffers (calculated at 100' wide per stream crossing)

Roads on landslide prone landscapes have the potential to fail and contribute large quantities of sediment to streams. Some roads may remain unstable over time and may contribute to chronic sediment erosion if not stabilized. Watersheds are considered in a high condition when landslide prone road densities are less than 1 mi/mi^2 (NOAA, 1998). Landslide prone road densities are less than 0.1 mi/mi^2 and in a high (good) condition on federal lands. This is due to a lack of landslide prone areas in the drainage. There are a few roads on very steep slopes on State/private lands; however most were built in stable locations. No recent road related slides were evident in Google Earth in the Lolo watershed.

Road sediment delivery risk was initially assessed for the existing condition using the WEPP:Road model (included in the NetMap Tools application). The WEPP:Road analysis considered the 558 miles of Forest Service managed roads prior to proposed activities. Of all the miles on the specified system, almost half are graveled. Six miles of the main haul route on the 100 road next to Lolo Creek is paved.

Because the WEPP:Road model was only partially calibrated with local data, the resulting outputs were qualitatively used to guide field reconnaissance to help focus field time and identify the actual highest risk roads that could benefit from road improvement treatment. The WEPP model identified about 2% (10 miles) of all roads had a moderate risk, and 1% (4 miles) had a high risk of delivery. This initial effort resulted in prescriptions to add cross drains on roads that had ditches that could introduce sediment into nearby perennial streams.

During interagency discussions of this BA for LID, a conflict between early modeling outputs and instream data was identified and discussed by Level 1 team members in NMFS and USDA FS. Specifically, the WEPP;Roads model considered most roads very low risk for chronic sediment input while instream sediment data indicates most reaches with actual data are still considered degraded to highly degraded. While some sampled stream segments have seen some modest improvement since PACFISH was implemented (Table 10), actual recovery of stream sediment conditions has yet to occur for most of the segments surveyed. Because of the importance of the steelhead population in Lolo Creek, the USDA Forest Service agreed to complete additional analysis at NMFS' request. In discussions between agencies, the USDA Forest Service agreed to run an additional model called GRAIP-Lite.

GRAIP-Lite was selected and used in the winter of 2018/2019 because the Nez Perce Clearwater National Forest did not have enough field data to re-analyze additional single road specific treatments with WEPP:Roads. (With additional data, the WEPP approach may have allowed predictions to guide additional mitigation and restoration treatments.) While GRAIP-lite is not designed to address single road segments without field data, GRAIP-lite can identify general areas within a watershed where sedimentation is more likely to occur. GRAIP-lite also provides a more accurate prediction of road use generated sediment at the entire project scale because the GRAIP-lite model is calibrated with empirical data from a very similar watershed that has both similar drainage patterns and erosive granitics as the Lolo watershed (Walters, personal communication). The results for the baseline condition are displayed in Table 10. The amounts displayed by sub-watershed, while considered more accurate than general estimates derived by WEPP:Roads, are likely higher than actual amounts because of differences in data accuracy and improved conditions from consistent road maintenance. Also, some of the data describing roads in corporate data layer may not actually represent field conditions.

Table 10. Existing sediment delivery from roads as modeled by GRAIP-lite.

Watershed (HUC12)	Existing Modeled Sediment Delivery (tons/year)
Eldorado Creek	337.5
Middle Lolo Creek	202.0
Musselshell Creek	234.5
Upper Lolo Creek	346.0
Total	**1119.9**

Riparian Areas: Riparian areas are dominated by cedar, other conifers, and alder. There are wide varieties in age and size classes of riparian trees which provide for current and future instream wood recruitment. An analysis of RHCA age classes shows that 58% of the trees within RHCAs are older than 100 years and capable of providing woody material and shade to streams now and into the future. Roughly 23% are between 50 and 100 years and the remaining 19% are less than 50 years old (Map 9, Appendix A). Overall the majority of riparian areas (81%) on Forest managed lands are well vegetated which will provide for both current and future woody material delivery and shade to streams. Because over a 160 miles of road are located in RHCA's in this watershed, a potential exists for some of the riparian delivered wood to be removed, based on PIBO data and subsequent published literature that found statistically less wood in streams when the streams were close to a road (Meredith, Roper, and Archer, 2014). Wood plays and essential role routing and storing sediment, storing run-off and maintaining ground-water, increasing channel complexity, moderating water temperature, and ultimately improving conditions for both juvenile and spawning steelhead as well as other fish species.

Channel Condition and Dynamics Indicators

Water Yield uses equivalent clearcut area (ECA) as an indicator of change in water yield or peak flows resulting from reductions in forest canopy (thinning and harvest-related activities). The model analysis uses treatment and recovery coefficients derived from Ager and Clifton (2005) to determine existing ECA and the percent increase as a result of harvest activities at the subwatershed (HUC12) scale. Google Earth image analysis was used to determine date and acreage of harvest on private lands in the Musselshell and Middle Lolo subwatersheds. ECA was not calculated for the Lolo Creek HUC10 watershed.

The ECA analysis takes into account the initial percentage of crown removal and the recovery through vegetative regrowth since the initial disturbance. This indicator serves only as a red flag that suggests a potential for decreased stability due to sustained increased energy in the stream channel. The potential risk for channel alteration in 3rd to 5th order drainages increases when peak flow increases are 15 to 20% or average annual flows increases over 10 to 15% (Patten and Jones, 2005). This level of change is typically observed when 20% or more of a forested watershed has a treatment equivalent to a clearcut such as harvest or a road or wildfire that kills mature trees. Grant et al. (2008) concluded that detectable increases in peak flow are usually not detected until 19% – 29% of a watershed is harvested, generally following clearcut prescriptions. King's studies (1994) conducted on the Nez Perce National Forest showed that while there was evidence of peak flow increases in the headwater first and second order streams, they were cumulatively not detectable on the main stem (third order). The Forest typically uses 20-25% for HUC12 subwatersheds as the

threshold where channel changes may be detectable from increased flows. This threshold falls into the moderate condition class (ECAs of 15-30%) as defined by the Matrix of Pathways and Indicators.

Existing ECAs for HUC12 subwatersheds in the project area are as follows:

- Upper Lolo- 12% (High Matrix rating)
- Musselshell- 19% (Moderate rating)
- Eldorado- 9% (High rating)
- Middle Lolo- 17% (Moderate rating)

Current subwatershed ECAs are below the threshold of 20-25% where channel changes may occur as a result of increased water yield.

Sediment yield is currently above natural levels due primarily to roads within the watershed; however, data has not been collected to quantitatively predict the current yield. Instead, a modeled yield for current delivery from the road system was created February 2019 and disclosed in this BA. Please refer to the roads discussion above. Timber harvest occurring outside of RHCAS since 1995 and the implementation of PACFISH are not expected to contribute to sediment yield based on recent monitoring (USDA, 2016a, unpublished data).

PIBO measurements for ***width to depth ratios*** collected in Lolo, Yoosa, Musselshell, Eldorado and Mud Creeks indicate that these streams are within the Matrix high condition class (Appendix B). Low ratios likely indicate stable stream channels within the project area.

Streambank stability is high throughout the drainage due to large substrates (cobbles, boulders, and gravel) combined with dense streamside vegetation. Extensive Forest Service habitat surveys indicated consistent streambank stability at 95% or better in Lolo Creek and its tributaries (Appendix B). PIBO data also indicated good bank stability with ranges from 93 to 100% depending on the survey year. The result are streambanks that are vegetated well enough to withstand excessive erosion during normal and high stream flows.

Water Quality Indicators

Stream temperatures in late summer (July through September) are the warmest temperatures of the year and occur during the time period when spring Chinook salmon spawn and juvenile incubation begins. Temperatures throughout the remainder of the year are all within preferred temperatures for steelhead and cutthroat trout spawning, and trout and salmon incubation and rearing.

Temperature has been monitored extensively throughout the Lolo Creek drainage. A total of 20 streams have been monitored anywhere from 8 to 24 years between 1990 and 2016. Stream temperatures fluctuate widely across the years depending on weather and stream flow patterns. The warmest year in the record was in 2007.

Streams with the consistently highest temperatures were the mainstems of Lolo, Eldorado, and Musselshell Creeks regardless of the weather pattern. This is in part due to about 700 acres of meadow habitats along portions of these streams. Overhead cover is lacking in these areas due to high water tables which limit tree growth. Forest Roads 103, 100, 500 and 535 are adjacent to portions of these streams and may also contribute to stream heating. Cattle grazing on private lands likely influences temperatures in Musselshell Creek.

The 7-day maximum average water temperatures within these mainstems ranged from 20° to 25° in 2007. The coolest maximum temperature for these streams was 18° or less and occurred in 1995, 1999, or 2008. These streams did not meet the preferred temperature of 12° for *salmon spawning* in any year; however,

salmon successfully spawn on an annual basis in Lolo and lower Eldorado Creeks. Neither of these streams met the optimum *summer rearing* temperatures of <18° in any year. Musselshell met the summer rearing temperature 6 out of 19 years. These streams are considered marginal for summer rearing based on temperature regimes; however, chinook and steelhead juveniles have been observed throughout the streams during the summer months.

The tributary streams consistently had maximum 7-day average temperatures ranging from 15° to 18° in 2007. The coolest maximum summer temperatures ranged from 12° to 15° depending on the year and the tributary. A total of 15 of the 17 tributaries met optimum *summer rearing* temperatures for salmon and trout in all years. While lower Eldorado did not meet summer rearing temperatures, upper Eldorado met them 15 out of 17 years. Overall the tributaries meet the standards for salmon and trout summer rearing.

None of the tributary streams met the *bull trout spawning* temperatures of less than 9° and all but Gold, Chamook, and Nevada Creeks either met or were within 1 degree of meeting *bull trout rearing* temperatures (<15^{o}). Warmer than preferred spawning season water temperatures are thought to limit bull trout distribution in the Lolo Creek drainage. The mainstem of Lolo is most likely a thermal barrier to upstream migrating fluvial adults. The Lolo watershed likely did not support bull trout before forest management began a century ago.

The Idaho State identified beneficial uses for Lolo Creek are cold water aquatic life, and primary and secondary contact recreation. IDEQ has determined that Lolo Creek meets its beneficial uses. However, Musselshell, Eldorado and Dollar Creeks are listed as impaired for stream temperature based on a combined assessment of biota and habitat (IDEQ, 2011). A Total Maximum Daily Load (TMDL) report was written and was approved by EPA in 2011. Achieving these loads is expected to occur primarily through passive management. The average lack of shade in Eldorado, Musselshell, and Dollar Creeks was 16%, 14% and 20%, respectively. The Forest is expected to achieve TMDL loads primarily through maintenance of RHCAs.

The risk of ***chemical contamination and excess nutrient input*** into project area streams is considered low. Few vehicle accidents which could add contaminants to streams occur due to slow vehicle speeds created by the narrow winding roads. No fuel spills resulting in delivery to streams has occurred in over 20 years. Nutrient input from cattle are limited due fencing along the most sensitive fish spawning areas as well as thick riparian vegetation which limits cattle access to streams.

Habitat Access Indicators

***Natural Barriers*:** There is a natural bedrock falls one mile up from the mouth of Eldorado Creek which acts as a full or partial upstream migration barrier to fish depending on flows. At low flows when chinook are migrating, the vertical falls provides no jump pools for the fish. At high spring flows when steelhead are migrating, a 0.2-mile-long section of narrow, steep cascading stream above the falls creates very high velocities and few rest areas for migrating adults. It is assumed that at most years during most flows, passage for anadromous fish is not possible; however mid-1990's and recent IDFG surveys indicate the presence of *O.mykiss* above the falls.

Human Caused Barriers: There are 79 crossings on fish bearing streams on Forest Service lands. Of those 42 (53%) are passable to all aquatic organisms. The condition of the remaining crossings is unknown; however, most are expected to occur on small streams, are near the upper extent of fish distribution, or are only partial barriers for fish passage. These potential barriers restrict access to about 10 miles of stream (mostly cutthroat trout). A total of 26 of crossings have been replaced since 2001 with culverts that pass all aquatic organisms. Three pipes have been replaced with all-organism passage pipes on private lands in the Musselshell subwatershed; however the status of the remaining crossings is unknown. It is likely there are barriers to listed fish species, primarily steelhead. No barriers are known where Chinook are known to occur.

Habitat Elements Indicators

Cobble embeddedness data was collected in streams where timber harvest activities are proposed. Surveys were conducted in 2013. Resurveys were conducted in Eldorado, Musselshell and two sites in Lolo Creek in 2017. The results are displayed below in **Table** .

While the data shows that streams are currently in a moderate or low Matrix condition class, it also shows substantial decreases in embeddedness between 1991 and 2017 (**Table**). Decreasing trends have led to improved habitat conditions for aquatic species. Decreases are a result of road decommissioning, culvert replacements, PACFISH buffer retention since 1995 and improved road drainage and maintenance.

Table 11. Cobble embeddedness and percent fines <4mm in Lolo Creek and selected tributaries

Stream	Year	Weighted CE %	Matrix/Pathways Condition (%)
Upper Lolo HUC12			
Camp Creek	2013 1992	39 42	Low
Lolo Above Yoosa	*2017* 1993	*51* 65	Low
Mox Creek	*2013* 1997	*47* 97	Low
Musselshell HUC12			
Musselshell Above Tunnel	2013 1991	*45* 56	Low
Musselshell At Mouth	*2017* 2013	*38* 32	Low
Eldorado HUC12			
Eldorado at Mouth	*2017* 1992	*24* 17	Moderate
Cedar Creek	*2013* 1991	*45* 79	Low
Middle Lolo HUC12			
Lolo Above Eldorado	*2017* 1993	*24* 45	Moderate

PIBO data for pool tail fines (<6mm) collected at index sites in 2006, 2011, and 2016 was also reviewed. It showed variability among sites including a 4-6% decrease in fines in Lower Lolo, Musselshell and Eldorado Creeks, no change in Yoosa Creek, and a 9% increase in Upper Lolo and Mud Creeks. Pool tail fines percentages are typically higher than desired for most PIBO sites. Data collection sites are shown on Map 10, Appendix A.

Wood and Pools: All streams with the exception of Lolo and Musselshell Creeks, met the PACFISH objectives of 20 pieces/ mile of large wood. Lolo and Musselshell had 19 pieces/mile while the remaining streams ranged from 20 to 75 pieces. Low levels of wood generally equate to lower pool quality and frequency and overall lower quality fish habitat. These conditions were noted in the majority of the habitat surveys and verified by field visits. PIBO data indicates both increases and decreases in pool frequency depending on the sampling site. Wood levels throughout the drainage are expected to increase over the long term as a result of PACFISH implementation and past, current, and future RHCA road decommissioning. Pool frequencies are expected to follow the same trend over time.

Habitat refugia is adequate and available throughout project area streams due to relatively limited riparian disturbance in the past 24 years and a lack of artificial barriers present in the watershed.

Take Indicators

Harassment risk for listed fish species is considered low due to a lack of direct vehicle and foot access to streams as well as low angling and camping use throughout Forest Service lands in the Lolo drainage. Cattle grazing occurs along some riparian areas on FS lands. There are isolated stream crossings where harassment of juveniles could occur in the lower 5 miles of Upper Lolo HUC12, 6 miles of Musselshell HUC12, 1 mile of Middle Lolo HUC12, and about 5 miles in Eldorado HUC12. The majority of fish habitat is not directly accessible by cattle due to steep slopes and thick and unpalatable riparian vegetation which limits harassment potential on FS lands. Cattle grazing has the potential to affect redds on State/private lands in the Musselshell subwatershed on at least 40 noticeable sites (Google Earth). A total of 2 miles of riparian exclusion fence around riparian areas and habitat has occurred along the mainstem of Musselshell Creek.

Redd disturbance risk for listed fish species is considered low throughout the drainage due to a lack of direct vehicle and foot access to most streams, and higher flows occurring during spring runoff when steelhead typically spawn. Human use within the drainage is mostly associated with road travel and not streamside use. Dispersed campsites in general are not located near spawning habitat, therefore potential redd disturbance is unlikely. The most sensitive steelhead and chinook spawning areas are either fenced or inaccessible to cattle due to vegetation or steep slope angles. Little disturbance to redds by humans or cattle have been observed in the past on FS lands. Redd trampling may occur on State/private lands in the Musselshell HUC12.

V. Analysis of Effects

Sediment Modeling*:* Originally, the Disturbed WEPP erosion model (Elliot et. al. 2000) was used to estimate potential delivery from timber harvest and temporary and permanent road construction activities. The model predicts the level of erosion and the probability of sediment delivery from combined erosion and runoff events based on the following factors: climate, slope steepness, soil type, and percent vegetative cover. Model simulations were run assuming a 60-foot riparian buffer for all units with exception of the RCHA intermediate harvest units with proposed riparian harvest where the buffer was reduced to 10 feet to create a conservative estimate. In winter, 2019, GRAIP-lite was also run to increase understanding of potential road use effects from haul. Results of modelled haul using GRAIP-lite are discussed later in the document.

BMP /Design Feature Effectiveness

Best Management Practices (BMPs): BMPs would be followed for all action alternatives as stipulated by the Idaho Forest Practices Act. Idaho water quality standards regulate non-point source pollution from timber management and road reconstruction activities through the application of BMPs. Idaho State Water Quality BMP monitoring indicates BMP compliance rates across all ownerships (federal, state, private industrial, private non-industrial) at 96% or higher (IDEQ 2016 and 2013). This has been an improvement since 1984 when compliance was 82%. Compliance has been over 96% since 1996. Harvest and stream protection rules had a 98% compliance rate in 2016. The Clearwater National Forest has an excellent record of successful implementation of BMPs. Between 1990 and 2008, the Forest had a BMP implementation and effectiveness rates of >95% (USDA Forest Service, 2003, 2008; Connor and Snyder, 2016). These reports can be found on the world wide web at: http://www.fs.usda.gov/detail/nezperceclearwater/landmanagement/planning/?cid=stelprdb5408439 . The same BMPs are applied to the Lolo Insect and Disease Project and are expected to have similar results.

PACFISH RHCAs: All management activities since 1995 implemented PACFISH buffers in order to eliminate or reduce impacts to riparian areas and streams. Monitoring results from the PACFISH/INFISH

Biological Opinion (PIBO monitoring across the Upper Columbia River Basin) indicate improving trends in pool depth, bank stability, large wood frequency and volume in both reference and managed sites (USDA Forest Service 2012). A summary of PIBO data collected between 2001 and 2013 just within Region 1 of the Forest Service showed desired trends in all parameters except for percent pools (USDA 2016, unpublished report). Percent pools had an overall 2% decrease where increases would have been expected. The overall percent pool tail fines (a measure of fine sediment) decreased by 14% within the region which is the desired trend for sediment. The data suggests that RHCAs are highly effective at reducing impacts to riparian areas and streams from management activities.

Harvest Effects

Water yield would not be expected to be measurably affected by project activities with the possible exception of Musselshell subwatershed. Vegetation removal activities would occur on less than 5% percent of the four subwatersheds analyzed. Post-project ECA levels are:

- 14% for Upper Lolo
- 13% for Eldorado Creek (High Matrix condition),
- 18% for Middle Lolo (Moderate rating), and
- 24% for the Musselshell Creek subwatershed (Moderate rating). While Musselshell is just under the threshold of 25%, the percent increase in peak flows are not expected to cause measurable in-channel alteration in, given harvest requirements for 14 to 40 trees retained in the 650 acres of regeneration units.

Timber harvest and temporary and permanent road construction would not affect sediment levels or habitat in streams. WEPP modeling was conducted for each of the subwatersheds. Model results indicate a 10% to 37% probability of sediment delivery to streamside buffers and a 0% probability that sediment would be delivered to streams past riparian buffers. Modeling results coincide well with local post-harvest field monitoring where no sediment delivery to RHCAs was observed. A total of 23 miles of RHCAs and 5.5 miles of temporary road was monitored on the Lochsa District in 2014 after timber harvest and burning of the units was complete (USDA, 2016a, unpublished report). There was no evidence of sediment moving from harvest units into RHCAs or sediment moving from temporary roads into harvest units or RHCAs. The thick buffer vegetation and retention of downed woody debris and ground vegetation within the harvest units provides structures that capture sediment and slow or stop its movement down the slope. Similar results have been observed in the field since 2000 (K. Smith, personal observations).

Stream temperatures would not be affected by proposed activities due to RHCA retention. Buffers of 100'-150' adjacent to streams within timber sales have been shown to be adequate in protecting the riparian vegetation necessary to maintain natural stream temperature levels (Anderson and Poage 2014; Ott et al 2005; Lee et al 2004; Sridhar 2004; FEMAT 1993). PACFISH buffers greatly exceed these guides on fish bearing streams and meet the guides on non-fish bearing and intermittent streams.

Site Prep Effects

No effects to fish or their habitat are expected from site preparation activities as all occur outside of RCHAs and typically occur in the late fall, winter or spring months when soils are moist or wet. Burning at this time limits damage to the duff and soils as well as limits the risk for starting a larger fire.

Soil Restoration Effects

No effects to fish or their habitat are expected from soil restoration activities as none would occur within 30' of streams. The streams are fishless and small in size and the decompaction activities leave the disturbed

ground in a state that limits erosion potential. In addition, the 30' no treatment zones are well vegetated and contain large quantities of downed woody material which could trap any sediment. Local monitoring of road decommissioning show little erosion after decompaction occurs.

Road Preparation Effects

Road reconditioning includes brushing, blading, and spot surfacing roads with gravel where needed. Blading and rocking is done to provide an even and reinforced running surface that can withstand truck traffic. Cleaning ditches would maintain or improve drainage. Activities would only remove material where ditches are plugged or not functioning. Long lengths of ditch would not be bladed in order to retain the existing vegetation that acts as a sediment filter and reduces potential delivery to streams. Effects to streams from roads reconditioning are expected to be negligible; so too for brushing and spot surfacing. Blading has the potential to deliver sediment to streams as a result of road surface disturbance with delivery points only likely at live stream crossings. The risk and any amount delivered is considered low due to the presence of existing cross drains near streams or the addition of new cross drains. Delivery has only been observed on a rare occasion on the Forest when blading occurred while it was raining. Blading in the rain is no longer an acceptable practice and would not occur.

Road reconstruction includes the addition of cross drains where necessary and the replacement of 21 small undersized existing culverts, two of which are within 600' of steelhead occupied or designated critical habitat. The addition of cross drains would improve drainage and reduce potential sediment delivery to streams. This is supported in a study by Sugden (2018) who found an average 46% reduction in sediment delivered to streams in Montana and Idaho after systematic BMP road upgrades were conducted. No effects to streams from cross drain installation are expected since they do not involve live streams and have no mechanism of delivery to streams.

Culvert replacements occur on non-fish bearing streams and would be sized for a 100-year flow event to reduce the risk of plugging and failure. All replacement culverts are 18" to 36" diameter pipes. Replacement activities would cause short-term localized sediment delivery when stream crossings are removed, replaced and the stream rewatered (Foltz et al., 2007). Seven replacements would occur in the Upper Lolo subwatershed, 13 in Eldorado, and one in the Musselshell subwatershed. This amount is considered negligible within each of the subwatersheds and across the project area. BMPs to limit sediment delivery to streams would be implemented (Appendix C). The most important include limiting the work period to the low flow summer months, dewatering work sites, and the installation of sediment control devices both instream and on road fill slopes upon completion of the project. Amounts of sediment that could be mobilized during replacement with BMPs followed during low flow are minimal when compared to what may happen during culvert failure in infrequent and extreme weather events.

Culvert replacements would not result in direct mortality or harassment of listed fish species as they do not occur at any of the removal sites. Indirectly potential displacement or harm of steelhead as a result of increased turbidity could occur at 2 replacement sites in the Upper Lolo subwatershed. These sites are within 600 feet of occupied critical habitat and within 0.3 mile of each other. Both streams drain into Lolo Creek. One stream is about 8" wide and just under 600' from Lolo Creek. The other 36" wide and 100' from Lolo Creek. Sediment delivered would likely remain along the margin of Lolo Creek and would be quickly be diluted by its large flows. Some juveniles may experience minor increases in turbidity. On-forest monitoring indicates sediment rarely travels more than 600' downstream during low flow periods (USDA Forest Service, unpublished data); therefore the effects are expected to remain localized and short-term in nature (1 day per site). The long-term benefit of culvert replacements is the reduction of potential future crossing failure risk.

Road reconstruction and reconditioning would address chronic sediment production to a degree and reduce it through improved drainage, application of aggregate surface materials, and addition of cross drains. Therefore, long term reductions in sediment yield from 157 miles of reconstructed or reconditioned road segments are expected.

Road Decommissioning and Storage Effects

Road decommissioning would remove 45 miles of road (Map 6, Appendix A). Of those, 14 miles are RHCA roads and would be fully re-contoured. Decommissioning would result in a 9% reduction in RHCA road miles on federal lands (Table 12). For the entire project area, known watershed road miles would decrease from 693 to 648 and densities would decrease from 3.7 to 3.5 mi/mi^2. RHCA road densities would decrease from 164 to 150 miles and RHCA densities would decrease from 4.6 to 4.3 mi/mi^2. Decommissioning would remove 63 stream crossings, an 8% reduction. Storage would temporarily remove 24 stream crossings, or another 3% reduction. While these positive improvements incrementally reduce the effects of roads, the watershed condition determined by using the resulting values in the Matrix would remain in the low category for both watershed and RCHA road density. Road storage would remove crossings and stabilize remaining road prisms needed for future management. Road storage does not affect road density but eliminates the risk for road failures at stream crossings and reduces failure risk on the remainder of the road.

Table 12. Pre- and post-decommissioning densities and stream crossings.

	Upper Lolo	Musselshell	Middle Lolo	Eldorado
Watershed Road Density				
Pre-project (mi/mi^2)	4.1	3.3[1]	3.2[1]	4.4
Post-project (mi/mi^2)	3.8	3.2[1]	3.2[1]	3.9
RHCA Road Density				
Pre-project (mi/mi^2)	4.0	5.7	5.9	4.4
Post-project (mi/mi^2)	3.8	5.2	5.7	3.8
Road Stream Crossings Removed				
Road Decommissioning	18	10	6	29
Road Storage	11	6	0	7

[1] Includes State and private land roads.

During road decommissioning and storage, short-term localized sediment delivery is likely when stream crossings are removed as described previously for culvert replacements. The majority of removals occurs within the Eldorado subwatershed, followed by Upper Lolo, Musselshell, and Middle Lolo subwatershed.

Direct mortality or harassment of listed fish species are not expected as they do not occur at any of the removal sites. Potential indirect displacement or harm of steelhead as a result of increased turbidity could occur at four culvert removal sites which are within 600 feet of steelhead critical habitat. Two occur in the Eldorado subwatershed where steelhead are found in very low densities due to the presence of Eldorado Falls. Minor sediment delivery to Eldorado Creek may occur and may result in increased turbidity along the margin of the creek. It will be quickly diluted due to the large volume of water in Eldorado when compared to the tributaries volumes. One removal is in Camp Creek, a tributary in the Upper Lolo subwatershed. This stream is very small (12” wide) and unlikely to deliver any visible sediment to Camp Creek due to very low stream flows and the 550’ distance to Camp Creek. The last removal is an unnamed tributary in the lower reach of the Upper Lolo subwatershed. This stream is likely less than 8” wide and has only a trickle of flow during the summer. Any sediment delivery from this removal would be quickly diluted by flows in Lolo Creek. Indirect effects to listed species or their habitat would be localized and short-term in duration.

There are 24 crossing removals associated with road storage but none are within 600'of critical habitat; therefore no effects to listed fish or their habitat resulting from turbidity of the removal would be expected.

The reduction in system road and RHCA road densities are expected to result in improvements in long term sediment yield due to the removal of 63 decommissioning associated stream crossings and 24 storage related crossings. These activities are expected to result in long term sediment reductions to spawning and rearing habitat through road and crossing failure risk reduction or elimination.

Modelling results to help predict long term improvements to reduce the effects of the existing network were also produced by GRAIP-lite. The modeling identified 100 tons/year of less sediment delivered to streams from the roads that will be decommissioned and treated in the Lolo watershed by the LID project. This number is 9% of modelled chronic sediment delivered by the existing road system annually (1,100 tons). In a typical year, the model results may either over or under-estimate the sediment contributions from roads planned for decommission and treatment. The amount could be overestimated because of the type of parent material, decomposing granitics, found in the headwaters. Streams identified and transferred to maps from aerial imagery, or drawn from hydrological models, may not actually exist in reality, or the streams that do exist could be smaller, as runoff could go subsurface in this kind of landscape. (Vince Archer, personal communication).

Amounts could also be under or over-estimated because of the inner workings of the model. Stream location in the model is generated by a Digital Elevation Model (DEM). While the stream layer is created by DEMs, the resulting location may not be exactly where the stream is physically located in reality. If the stream is closer to the road location on the ground, the model underestimates. If it is farther away on the ground, it overestimates. Also, road locations in the Forest roads database may not be precisely located, leading to similar challenges. Therefore we visually examined graphical outputs for three roads planned for removal in upper Lolo Creek subwatershed with highest predicted chronic sediment delivery. Using GRAIP-Lite to examine outputs road by road is a finer scale than the intent of the model (T.Black pers com). However, considering outputs in this fashion helped us find inaccuracies with input data. We inspected the GIS maps for roads 5038 (12.1 tons delivered), 5186 (6.0 tons modeled delivered) and road 5223 (4.9 tons modeled delivered). At first, we thought the amount predicted for 5038 was over-predicted because we assumed there were more contribution points identified in the model than actually likely occur. Yet, when we considered the entire road length, combined with the fact that we don't know exact road gradient near contribution points, we now consider this estimate to be reasonable. We considered numbers predicted for the other two roads investigated were representative of road and stream locations and resulting interactions. Therefore given the potentials for both over and underestimating typical sediment delivery amounts, and the fact the three roads we examined with map layers seem plausible, we assume that the 100 tons a year is representative of what actually might be delivered to streams by the set of roads that are planned for decommissioning.

Dust Abatement Effects

Dust abatement on log haul roads is designed to minimize the amount of road related sediment (via fugitive dust and road surface erosion) added to streams. A 1993 study by Sanders and Addo showed that dust abatement produced half the amount or less of dust as untreated graveled roads. They also showed that traffic speeds affect the amount of dust produced. Slower traffic speeds (20 -30 mph) produce half as much dust as higher speeds (40+ mph). Log haul traffic speed is not expected to exceed 25 mph and would be closer to 15 mph due to the narrow, twisty road network in the project area. Monlux (2007) found a 90% reduction in observed dust after abatement treatments. He also found that the dust abated roads required less surface

blading than untreated roads. All haul roads would receive dust abatement treatments as necessary prior to log haul.

No contamination effects to fish species from dust abatement application are expected due to the design features that eliminate the potential for direct application into streams including: not applying chemical abatement materials with 24 hours of expected rain, minimizing the treated road width and leaving a minimum one foot no-treatment strip from the edge of the road inward. These design features minimize potential runoff and delivery of abatement chemicals. Research suggests that magnesium chloride does not travel far from where it was applied (Slesser 1942 [cited in USDA Forest Service, 2016b]). Goodrich et al (2009) also found that although chemicals were found in some streams in Colorado, the concentrations detected were below those reported to adversely affect fresh water aquatic organisms.

Log Haul Effects

Log haul can generate sediment as a result of road surface erosion related to rutting and displacement of road-bed material, creating conditions conducive to higher sediment delivery rates (Reid and Dunne, 1984). While considerably less than native surface roads, sediment is also generated and delivered by road use, even when high quality gravel is added and maintained on the road surface. Chronic sediment delivery to streams occurs primarily through ditchlines that are hydrologically connected to live stream crossings. Project design would install cross drains where needed to disconnect the ditchlines. Assuming crossdrains are in place, portions of about 7 of the 30 miles of haul road within 600' of occupied critical habitat and would remain connected to stream channels with the potential to deliver sediment (65 total stream crossings). It should be noted that by installation of cross drains, some of the new drainage points may deliver to the forest floor and therefore will not introduce sediment, assuming roughness and ground vegetation will capture sediment. Given there are 65 crossings, 18 of which occur on fish bearing streams, the risk is *probable* that 18 crossings could add sediment to Musselshell, Gold, Lolo, Yoosa, Eldorado, and Cedar Creeks. Thirteen are graveled and directly over occupied habitat. These pose the greatest direct risk to steelhead and their critical habitat. The duration of haul (up to 5 years) and amount of haul on Roads 103, 500, 519, and 520 maintains that risk at these sites. No sediment is expected from the 20 crossings within 600' of Lolo Creek on Forest Road 100 as this road is paved in its entirety. Additional actions as a result of monitoring or calibration review may include moving cross drains away from direct contact with upper Lolo Creek which would reduce the potential for haul generated sediment from reaching the stream.

Although likely to occur, sediment delivery to streams is expected to be minimized due to mostly graveled roads when combined dust abatement and maintenance of proper drainage during log haul. Arismendi et al (2017) found road construction, forest harvest, modern road maintenance techniques, and hauling did not result in significantly higher median suspended sediment or turbidity downstream compared to upstream of road crossings. While this study supports improved management practices like those that occur on the Forest to reduce suspended sediment, the authors warn not to interpret their results too broadly. Dust abatement would be applied in each year that a road is used in order to maintain its effectiveness during haul. In some years, depending on conditions, log haul may also occur during winter when roads are frozen thus reducing potential delivery to streams. Proper drainage would be maintained during hauling operations as directed by Forest Service contract administrators. Regular inspections of haul roads and recommendations from calibration reviews, particularly within 600' of critical habitat, would also help to identify and correct any road problems that could lead to delivery to streams.

GRAIP-lite Modeled Effects from Road Work and Use

Overall application of the GRAIP-lite model considered log haul, temporary and permanent road construction, and road decommissioning. Because of the amount of roads in the project area and the fact that over 100 miles are within RHCAs, it is clear that effects from haul are in *proximity* and a have a high *probability* to occur. While the model has not been site-specifically calibrated for the project area, it is correlated to the project area with carefully collected empirical data from a similar lithology in the Boise Watershed. The model is not intended to give precise estimates for point locations. Rather, it is effective at comparing subwatersheds, identifying general areas where sedimentation has a greater chance of occurring, and predicting sediment volumes for dozens of miles of roads (T. Black, personal communication). The results are therefore useful for comparing between the baseline, during-project, and post-project conditions for the four subwatersheds in the project area (Table 13). The results of the modeling indicate an increase in sediment delivery during activities of significant *magnitude* to have an adverse effect on steelhead in the short term (less than 5 years) in timber sale areas where road management activities and haul occur and an overall reduction in delivery after the project is completed which is likely to have minor beneficial effect. Reductions occur primarily as a result of road decommissioning and subsequent treatment, cross drain relocations, and maintenance treatments applied during road use.

Table 13. Alternative 5 modeled sediment delivery pre, during, and post-treatment for all roads in the project area in tons/year.

HUC 6	Current Conditions	During Implementation		Post Implementation	
	Tons Delivered	Tons Delivered	Percent Increase	Tons Delivered	Percent Decrease
Eldorado Creek	337	789	134%	299	11%
Middle Lolo Creek	202	271	34%	193	4%
Musselshell Creek	235	571	144%	213	10%
Upper Lolo Creek	345	741	114%	313	10%
Total	**1,119**	**2,372**	**112%**	**1,019**	**9%**

Like the earlier description in this BA regarding effects resulting from road decommissioning and treatment, haul and maintenance BMPs, we consider the values presented for "During Implementation" may be both under and overestimated, especially when looking at only a few miles of road. First, the model is run with available data and applies worst case scenario (native surface roads) when the data associated with the spatial layer is not populated. Second, the model runs all treatments at one time. The amount displayed for all treatments applied concurrently does not represent how timber sale offering areas and road work occurs. Several offering packages will be developed to complete all the work proposed by LID. While there will not be the large amount introduced simultaneously as shown in the GRAIP-Lite estimate, the modeled total amount would be predicted to occur in smaller introductions over a longer time period. While this tends towards a more chronic event, it also allows for individual areas within the watershed to begin recovery more quickly. The estimated 9% overall reduction shown in the table includes all maintenance, decommissioning, and use of the road system proposed by the project. Cross drain relocations/additions/modifications would help protect the most important spawning habitat in the watershed and any remaining additions elsewhere would help to reduce overall sediment delivery from roads. All cross drain work would occur before haul begins on the road.

Fine sediment *duration* generated by road construction, maintenance and haul is expected to last 5 years for each timber sale offering area, and could last longer. Brush disposal and under-burning are sequential activities that occur after tree harvest is completed; these activities may require roads for access. The timing of effects would occur over several years and could affect egg/early fry life histories of salmonid fish species emerging in spring and summer months. The *nature* of effects would interact with steelhead and Chinook eggs in the gravel, when steelhead, spring Chinook fry are newly emerged.

In fall and winter, juvenile steelhead use the space between gravel to hide during the daylight hours since these fish forage in low light conditions. For fish over-wintering in the project area, deposition caused by sediment introduction could cause relocation (typically expected to be less than 5 years) to juveniles and possibly to Critical Habitat both within the project area and within the influence of streams flowing out of the project area to lower Lolo Creek, although gradient outside the project is such that sediment resident time would likely be much less than 5 years. At the conclusion of project activities in 2029, sediment delivery is expected to be less than the amount delivered in the existing condition throughout the project area. For all adult fish species, a high intensity storm event over the area could produce a sediment plume that could stall migration for the duration of the storm, but migration would be expected to resume soon after.

Water Pumping Effects

Pumping water from streams for dust abatement or water use during slash burning operations are not likely to affect fish due to the screening required on all pump intake hoses and the likely use of many non-fish bearing streams. No reportable fuel spills associated with pumping from streams have occurred on the Forest, therefore no effects are expected due to continued BMP application which includes fuel containment under pumps and portable gas tanks.

Refueling Effects

No effects to fish or streams from helicopter fueling and servicing is expected due to the location of the service landings near ridgetops with no connection to water. No reportable spills from trucks delivering to fuel to landings have occurred on the Forest therefore the risk of a spill occurring is extremely low. No spills have occurred with previous harvest projects where helicopters have been used.

OHV Trail Construction Effects

No effects to fish or their habitat from the construction of the OHV connector trail would occur due to its location on a stable hillslope with no connection to streams. Proper drainage will limit the erosion potential of the road.

Summary: In summary, no effects to fish or their habitat from timber harvest and temporary and permanent road construction, site preparation, soil restoration, water pumping, refueling, or OHV trail construction are expected due primarily to their distance away from streams. Potential sediment effects are likely to occur from road related work including: reconstruction, reconditioning, decommissioning, storage, and log haul.

Design features and BMPs would be used, and are designed to, minimize effects to streams, fish, and their habitat. RHCAs would be retained on perennial and intermittent streams adjacent to timber harvest units. Temporary and permanent roads would be built along or near ridgetops with no stream crossings and no hydrologic connectivity to streams. Temporary roads are planned for obliteration within 2 operating seasons; some taking longer due to extenuating circumstances. Road reconstruction and reconditioning would install

cross-drain culverts to divert roadside ditch flow away from streams. A special effort at culvert realignment will occur next to the highest quality steelhead and spring chinook spawning habitat adjacent to Road 103. Road surfacing with gravel on both reconditioned and reconstructed roads and dust abatement would also occur where needed to minimize sediment production and delivery to streams. Road decommissioning and storage would remove all perennial and intermittent stream channel crossings, decompact road surfaces, and recontour roads within RHCAs to eliminate future stream crossing failures associated with roads.

The following Matrix indicators would be improved as a result of road decommissioning and road reconditioning, reconstruction, and dust abatement activities: *watershed road density, RHCA road density, cobble embeddedness* (see Appendix C).

The following Matrix indictors would be maintained: *landslide prone road density, riparian vegetation condition, water yield, width:depth ratios; floodplain connectivity, stream temperature, chemical contaminants, physical barriers (adult and juvenile), large woody material, pool frequency, pool quality, off-channel habitat, habitat refugia, harassment, redd disturbance, and bull trout subpopulation characteristics.*

The sediment yield Matrix indicators would experience short term degradation with long-term improvement as a result of road decommissioning and road reconstruction activities. Log haul is modelled to increase sediment delivery which also affects yield but the risk is lowered by effective BMP implementation and modern maintenance practices including updating design features and dust abatement activities. GRAIP-lite modeling supports this conclusion. Timber harvest would have no effect on sediment yield.

Cumulative Effects

The Endangered Species Act defines cumulative effects as "those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the action area of the Federal action subject to consultation".

Private lands in Lolo Creek are distributed throughout the Musselshell, Middle, and Lower Lolo subwatersheds. Activities on private lands include grazing, forest management, and to a lesser degree, farming. Grazing that may affect streams occurs primarily in the Jim Brown Creek drainage, a tributary to Musselshell Creek. State lands are also well dispersed in the three subwatersheds and are managed for timber harvest and grazing allotments. Extensive timber harvest has occurred on both State and private lands in the past, most recently in Middle and Lower Lolo subwatersheds as a result of the 2015 Carrot Ridge Fire. Harvest in the Jim Brown drainage, a tributary to Musselshell Creek, occurred from about the 1950s through the early 2000s. Forested stands are currently not of optimum harvestable age at this time. There are no known future foreseeable harvest or other major ground disturbing activities on State and private lands.

Populations of listed fish species are unknown on State/private lands with the exception of the mainstem of Musselshell Creek and Yakus Creek. Snorkel surveys in 2017 by Idaho Fish and Game found *O. mykiss* densities of 1.5 fish/100m^2 in Musselshell and 7 fish/100m^2 on Yakus Creek (a tributary to Middle Lolo Creek). No chinook were observed during the surveys on Musselshell Creek but they were found in low densities (up to 5 fish/100m^2) in Lolo Creek from Eldorado down to the mouth of the creek. Steelhead are known to be present in Jim Brown Creek; however, their population status is unknown.

The effects of past harvest and road building activities on State and private lands in the Musselshell and Middle Lolo Creek subwatersheds were analyzed and have been incorporated into the baseline ratings for ECA and watershed and RHCA road densities. These subwatersheds contain significant portions of State and private lands (Table 6). Post-project ECA levels are 14% for Upper Lolo, 13% for Eldorado Creek subwatersheds, a High Matrix condition, 18% for Middle Lolo, and 24% for the Musselshell Creek

subwatershed, a Moderate Matrix condition. Cumulative ECA remains below thresholds where changes in stream channel stability may occur. ECA was not calculated for the entire Lolo watershed (HUC10). Road and RHCA road densities remain in the Matrix Low category. Road improvements resulting from the project would not measurably increase public use of those roads. The existing conditions of roads open for public use do not currently limit access.

For the sediment analysis, livestock grazing and roads in riparian areas are the only activities considered for cumulative effects as they are the projects that are likely to cumulatively contribute to instream sediment. Harvest was not considered as Idaho Forest Practices Act compliance would be required on all State and private lands and is expected to minimize sediment delivery to streams. No road decommissioning is known or expected to occur on State and private lands due to the need for access to private properties.

There are about 225 miles of stream on non-federal lands in the Lolo Creek drainage. Grazing may occur on 30 miles (13%), mostly in the Musselshell and Jim Brown Creek drainages where grasslands dominate and streams are the most sensitive to grazing. There are an estimated 1,000 acres of grassland habitats where grazing occurs. Grazing also occurs on harvested timber lands but the acres are unknown. Potential impacts to streams are fewer in the forested areas due to steeper topography, difficult access to streams, and generally unpalatable vegetation. There are about 2 miles of fenced cattle exclosures on Musselshell Creek below the Forest boundary which eliminates grazing on 90 acres of stream adjacent land.

There were about 40 noticeable cattle stream crossings on State/private lands evident in Google Earth that are destabilized and likely contributing sediment to streams. These are relatively small areas (about 50 feet long each) compared to the total stream miles being grazed. Field reviews confirm isolated bank destabilization with the majority of streams being well vegetated by dense grass and some shrubs. Large areas of complete destabilization and sediment input were not evident. Grazing likely has some effect on stream temperature as it can limit the amount of overhead cover in streams. Jim Brown Creek is listed as a temperature limited stream by IDEQ which may be, in part, a result of long term grazing.

Stream temperatures are likely to continue to exceed State standards as a result natural high temperatures exacerbated by grazing adjacent to 30 miles of stream on State and private lands. Federal actions would be unlikely to contribute to warming stream temperature effects.

There would be no cumulative effects from road work or potential decommissioning on State/private lands since none is expected to occur. The condition of those roads is not known therefore it is assumed that they currently add, and would continue to add some amount of sediment to streams. Fish barriers resulting from crossings on these roads are unknown but are likely to remain if they occur. Two culverts were replaced in partnership with the Nez Perce Tribe on Jim Brown Creek in 2013. Both were partial barriers prior to replacement and were replaced with culverts that pass all aquatic organisms.

No cumulative sediment increases to Lolo Creek are expected as a result of the Lolo Insect and Disease Project when combined with other State/private activities. Negligible amounts of added sediment are expected from road decommissioning, storage and culvert replacement and no measurable sediment is expected from federal timber harvest activities. Sediment will likely be delivered as a result of log hauling activities; however BMP implementation is expected to minimize the amount. Activities on State and private lands would continue to implement BMPs as required by the Idaho Forest Practices Act; however grazing and road related activities are likely to continue to add sediment to streams in unknown amounts. The activities are relatively localized and because the Lolo Creek drainage is large, the amount of sediment added as a result of private activities are expected to be negligible at the watershed scale. Evidence that supports this conclusion are the cobble embeddedness levels measured in Lolo Creek just above Eldorado Creek. Effects seen here include any State/private activities associated with the Musselshell Creek drainage.

Embeddedness has noticeably declined from 45% in 1993 to 24% in 2017 indicating likely improved sediment conditions overall. Effects to listed fish and their habitat have likely improved as well.

VI. Determinations

Snake River Steelhead Trout

The project **"May Effect, Likely to Adversely Affect"** steelhead and their designated critical habitat. This determination is based on:

1. *Short term increases in sediment delivery to streams at 65 log haul crossing sites which are within 600' of occupied designated critical habitat. Of the haul routes, 18 occur on fish bearing streams and are the most likely to add sediment to occupied habitat. Potential effects to critical habitat primary constituent elements (freshwater spawning and rearing) could occur.* A total of 30 miles of gravel or native surfaced haul road cross over or are adjacent to critical or occupied habitat. Hauling could potentially affect individual juvenile steelhead trout particularly at the 18 fish bearing crossings. The potential effect is more than negligible given the duration and number of expected haul trips during the life of the project.

   IDFG found 0 to 7 fish/100m^2 at snorkel stations throughout the drainage in 2017. Densities are low along the mainstem of Lolo, Musselshell and Eldorado Creeks (<1.5 fish/100m^2) which are adjacent to the primary log haul routes. Habitat could be affected by increased turbidity and sedimentation but the effects are expected to be minimized primarily through cross drain installation and dust abatement activities. The risk to fish is low given their low densities along the haul routes.

   Standard design criteria and BMPs to minimize sediment effects, including dust abatement, cross drain installation, and maintenance of proper drainage. Design criteria and BMPs for log haul are described on pages 10-13 above and in Appendix C.

   Long-term benefits to steelhead and their habitat are expected from cross drain culvert additions. This activity is consistent with actions identified in the Proposed Recovery Plan for Snake River Spring/Summer Chinook and Steelhead Populations (NOAA, 2017).

2. *Short-term increases in turbidity at 4 stream crossing removal and 2 replacement sites associated with reconstruction which are within 600' of occupied designated critical habitat. Potential effects to critical habitat primary constituent elements (freshwater spawning and rearing) could occur.* Work at these sites could potentially affect individual juvenile steelhead trout as well. Effects are expected to be low because stream sizes are a maximum of 36" wide with very low flows during the implementation period. Turbidity increases downstream from the Lolo and Eldorado Creek removal sites would be localized and short-term in nature as a result of diluting flows from the mainstem streams. Delivered sediment would travel downstream and settle in spawning and rearing habitat and would likely be flushed further downstream during spring high flows. Turbidity increases are not expected from the Camp Creek tributary removal site due its distance and very small stream size.

   One culvert replacement on Lolo Creek would likely result in turbidity effects to steelhead and short term delivery of sediment to spawning and rearing habitat near the site. The other site is on a very small tributary with low flows. Turbidity generated from this replacement is not likely to reach Lolo Creek.

   Steelhead within 600' of culvert removals or replacements could experience increased turbidity but the risk is low based on IDFG surveys in 2017. Fish were found in low densities (<1.5 fish/100m^2) in

Eldorado Creek near two removal sites but were not found in the mainstem of Lolo Creek where the activities would occur.

Standard design criteria and BMPs to minimize sediment effects during crossing removals and replacements would be applied, including deferral of work at these sites until after July 15. Design criteria and BMPs for crossings are described on page 9 above and in Appendix C.

Overall, the project would small amounts of sediment as a result of culvert replacements and removals at 6 sites near steelhead spawning and rearing habitat in Lolo and Eldorado Creeks. The amount of sediment would be low, localized and short term (0 to 2 years). Although these activities would add sediment, and have the potential to affect the quality of critical habitat, they would provide long term benefits to the stream systems and the continued improving trend in sediment trend found throughout project area streams. These activities are consistent with actions identified in the Proposed Recovery Plan for Snake River Spring/Summer Chinook and Steelhead Populations (NOAA, 2017).

Log haul activities are also likely to contribute sediment to spawning and rearing habitat; however the addition of cross drains, maintenance of proper drainage, and dust abatement are expected to minimize the amount.

In conclusion, the project will not result in persistent, measurable increases in sediment delivery, and that sediment delivery will decline at least 9% and likely more once the project is completed. It is unclear whether or not cobble embeddedness will decrease as a result of reducing amounts of sediment delivered from the road system.

Cumulative effects to mainstem Lolo Creek on State of Idaho and private lands. Cumulative effects to mainstem Lolo Creek downstream of the Forest boundary are addressed on pages 36-37.

Effects to water yield from this project are not expected in fish bearing streams in the project area. As described on page 29, ECAs for the four assessed subwatersheds remain below the threshold of 25%; therefore, cumulative effects in mainstem Lolo Creek related to water yield are not expected.

Grazing and road use on private lands would continue to affect fish and their habitat. The amount of the effect cannot be determined; however it is expected to be maintained at current rates. When combined with proposed Lolo Insect and Diseases Project activities, sediment may decline in the long term as a result of culvert replacements, removal and the installation of cross drain structures on roads on federal lands, and reductions in road density. The likelihood of degradation in the quality and quantity of critical habitat is low due to the expected small amount of project sediment added.

Effects to Steelhead Essential Physical and Biological Features

The new critical habitat regulation (81 FR 7414) replace the phrase Primary Constituent Elements (PCEs) with the term; Essential physical and biological features (PBFs). There were six PCEs developed for Steelhead trout critical habitat, only those that apply to freshwater habitats are applicable for this project and are discussed below.

(1) ***Freshwater spawning sites*** *with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.*

(2) ***Freshwater rearing sites*** *with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks*

Potential effects to these PBFs are discussed together since they are assumed to occur in the same places within the Lolo Creek drainage.

Effects to water quantity as measured by ECA are not expected. There are no other known effect pathways for water quantity associated with this project. Because activities in streamside RHCAs that could affect floodplain connectivity are not proposed, no effects would occur.

The culvert replacement and removal activities at six sites within 600 feet of designated critical habitat could cause a short-term decrease in substrate quality. Instream activities during the culvert replacement and removals are expected to introduce measurable, but localized, amounts of sediments generally within 600 feet of the culvert sites in critical habitat. Forest monitoring efforts regarding culvert replacements have indicated two turbidity spikes of less than two hours each during culvert replacement. At selected culvert replacement sites, turbidity is taken at 100' and 600' downstream of the site, after dewatering and after re-watering, until background levels are reached. The first spike occurs during the stream diversion work (dewatering) and the second when the stream is diverted back into the new culvert (re-watering). Turbidity increases are highest directly downstream of the culvert site and dissipate downstream due to mixing and settling. The first spike, sometimes but not always, exceeds the State turbidity standard (50 NTUs) at the 100' sample but generally not at the 600' sample. The second spike, during re-watering, most often exceeds the standard for 15 minutes to two hours and occasionally longer, at the 100'sample and sometimes at the 600' sample. Generally, turbidity returns to background levels within two hours after re-watering.

The sediments and increased turbidity settle out downstream; the distance is dependent upon the stream size and stream flows. This increase in sediment transport may result in short term and temporary increases in sediment deposition downstream of the culvert site. None of the replacements or removals occur on fish-bearing streams and all occur on small streams. Turbidity levels are therefore likely to be minimal as a result of very low flows at the time of implementation. Steelhead spawning and rearing habitat is present downstream from all six sites on the mainstems of Lolo and Eldorado Creeks. Instream work at the six sites is scheduled after July 15, thereby avoiding possible effects to downstream steelhead emergence in the fish-bearing mainstem streams. Although these activities would add sediment, they are expected to provide long term benefits to spawning and rearing habitat in Lolo and Eldorado Creeks downstream from the sites.

Mitigation measures employed by the Forest to avoid or minimize effects to critical habitat include stream diversions, restricted timing during low stream flows, gradual re-watering of the channel and the erosion control measures are described on page 9-10 and Appendix C. During excavation operations, streams will be diverted or pumped around the work sites. This will reduce turbidity and the amount of suspended sediment entering downstream reaches during the operation. Besides the two turbidity spikes during culvert replacement work, erosion and subsequent sediment transport from the culvert sites are minimal. Culvert removals, which remove a stable road prism and re-construct a stream channel with new stream banks, are prone to some channel scouring for at least one year until the new stream channel stabilizes.

Log haul within 600' of occupied steelhead critical habitat may deliver sediment to streams at the 65 graveled crossings where haul would occur. The greatest risk to steelhead spawning and rearing habitat would occur at the 13 fish bearing crossings over occupied habitat. Project design features that hydrologically disconnect roads from streams would occur; however a maximum of 500' of roadside ditchline would remain connected to each of the 65 crossings. Sediment is likely to be delivered to streams at a portion of these crossings; the amount would depend on the road configuration at each site. Delivery is most likely to occur during periods of rain and only for the duration of log hauling activities.

Mitigation measures employed by the Forest to avoid or minimize sediment effects include: dust abatement on all roads the same year that hauling occurs, hauling primarily during the dry season, and requiring road repairs if roads become damaged beyond acceptable levels (as determined by the Forest Timber Sale

Contract Administrator). During periods of non-use, roads must be left in a condition that ensures proper drainage and minimizes erosion potential. The design features and BMPs are implemented to reduce or eliminate potential effects to spawning and rearing habitat.

Timber harvest, site preparation burning, temporary and permanent road construction, and road reconditioning are not expected to result in increases in sediment yield. WEPP modeling indicates no potential for sediment delivery to streams from these activities.

The proposed actions could result in sediment being delivered to streams in the short term, but these increases are not at a magnitude where measurable increases in deposited sediment in steelhead spawning or rearing habitat are expected to cause long term degradation. They would be below levels that would result in adverse effects to invertebrate production, reduction in pool volume, or reduction of interstitial space needed by juvenile steelhead for rearing. Some long term beneficial effects to steelhead habitat are expected are likely to occur through road improvement and decommissioning activities, especially those road segments removed from RHCAs. The amount of improvement in substrate condition is unknown, as to date, little has changed in cobble embeddedness over the 24 years since PACFISH was implemented. GRAIP-lite modeling shows a 9% reduction in sediment delivery post-treatment.

Effects to natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks are not expected due to RHCA retention and the lack of instream work, other than culvert removals and replacement, none of which occur in occupied steelhead habitat.

(3) ***Freshwater migration corridors*** *free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.*

Migration corridors for steelhead trout would not be affected by this project.

Columbia River Bull Trout

The project **"May Effect, Not Likely to Adversely Affect"** bull trout. This determination is based on the following:

1) Available information suggests the mainstem of Lolo Creek may provide habitat for adult and subadult bull trout when conditions allow, generally from late September through May when temperatures are acceptable. Observations of adult bull trout on the lower mainstem of Lolo Creek below the project boundary are consistent with occasional use of the watershed by adults and sub-adults. Stream temperatures throughout the drainage are generally too high from June through early September for bull trout, with the possible exception of a headwater area in upper Lolo Creek.

2) Spawning and early rearing are not likely to occur in the Lolo Creek watershed. eDNA detection at this one site could not provide age class information; therefore, the reproductive nature of the detection is unknown. It is extremely unlikely that bull trout spawn and rear anywhere in the Lolo watershed. No redds or juvenile bull trout have been documented anywhere on National Forest lands in the project area during past surveys. Relatively high stream temperatures, particularly in August and early September would discourage spawning and early rearing. Observations of stream reaches at high elevations did not suggest an abundance of stream gradients or substrates preferred for bull trout spawning.

3) The project would result in negligible effects to mainstem Lolo Creek habitat for bull trout. Sediment may be delivered to streams from road work and log haul in upper Lolo Creek where bull trout eDNA

was detected; however, no measurable cumulative effect to the mainstem of Lolo Creek from project activities is expected as a result of design feature and BMP implementation.

There would be **"*No Affect*"** to bull trout critical habitat as none has been designated within the project area or Lolo Creek drainage.

Snake River Fall Chinook Salmon

There would be ***"No Effect"*** to fall chinook salmon as a result of proposed activities. Fall chinook do not occur in the project area and sediment effects from the project would be immeasurable at the forest boundary and therefore the mouth of Lolo Creek and the mainstem of the Clearwater River.

There would be ***"No Effect"*** to fall chinook critical habitat as a result of proposed activities. Fall chinook critical habitat does not occur in the project area and sediment effects from the project would be immeasurable at the forest boundary and therefore the mouth of Lolo Creek and the mainstem of the Clearwater River.

Snake River Spring/Summer Chinook Salmon

There would be ***"No Effect"*** to listed Snake River spring/summer chinook or their designated critical habitat as a result of proposed activities as the species was not listed and critical habitat not designated within the Clearwater River basin.

Sockeye Salmon

There would be ***"No Effect"*** to listed sockeye salmon or their designated critical habitat as a result of proposed activities as the species was not listed and critical habitat not designated within the Clearwater River basin.

Essential Fish Habitat

Implementation of the Lolo Insect and Disease Project "**May Effect, Likely to Adversely Affect**" EFH for Chinook and coho salmon based on potential effects from 2 culvert replacements and one removal within 600' of EFH on Lolo Creek. The potential effects are the same as those discussed for steelhead trout above. Log haul activities adjacent to and over EFH in the mainstem of Lolo Creek and the lower mile of Eldorado Creek could add sediment to salmon habitat. There are 3 fish bearing crossings and 15 non-fish bearing crossings where sediment could be delivered. Road decommissioning and improvement activities are expected to provide for long term sediment reductions in streams adjacent to and upstream from EFH. The implementation of design features, particularly dust abatement, and BMPs for all actions as described above for steelhead are expected to minimize sediment delivery to EFH.

References

Ager, A.A. and C. Clifton. 2005. Software for calculating vegetation disturbance and recovery by using the equivalent clearcut area model. Gen. Tech. Rep. PNW-GTR-637. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 11 p.

Anderson, P.D. and N.J. Poage. 2014. The density management and riparian buffer study: A large-scale silviculture experiment informing riparian management in the Pacific Northwest, USA. Forest Ecology and Management 316: 90-99

Archer, V., 2019. Regional Soil Scientist. US Forest Service. Region 1, Missoula, Montana. Personal communication.

Arismendi, Ivan, J.D. Groom, M. Reiter, S. L. Johnson, L. Dent, M. Meleason, A. Argerich, and A.E. Saugset, 2017. Suspended sediment and turbidity after road construction/improvement and forest harvest in streams of the Trask River Watershed Study, Oregon. Water Resources Research, 53 doi:10.1002/2016WR020198.

Black, T. 2019. Hydrologist. US Forest Service Research and Development, Boise, Idaho. Personal communication.

Brown, K. R., W. M. Aust, and K. J. McGuire. 2013. Sediment delivery from bare and graveled forest road stream crossing approaches in the Virginia Piedmont. Forest Ecology and Management, 310 (2013) 836–846.

Burroughs, E. R. Jr. 1990. Predicting onsite sediment yield from forest roads. Proceedings of Conference XXI, International Erosion Control Association, Erosion Control: Technology in Transition. Washington DC, February 14-17, 1990. Pages 223-232.

Burroughs, E.R. and J.G. King. 1989. Reduction of soil erosion on forest roads. General Technical Report INT-264. USDA-Forest Service, Intermountain Research Station, Odgen, UT. July 1989. 21 p.

Burroughs, E.R. and J.G. King. 1985. Surface erosion control on roads in granitic soils. Proceedings of Symposium Sponsored by Committee on Watershed Management, Irrigation & Drainage Div., ASCE, ASCE Convention, Denver, CO, April 30-May 1, 1985. 183-190.

Cissel, R., T. Black, N. Nelson and C. Luce. 2013. Center Horse and Morrell/Trail GRAIP Roads Assessment, Preliminary Report. Clearwater River Watershed, Lolo National Forest, Montana. US Forest Service, Rocky Mountain Research Station, Boise, ID.

Clearwater Biostudies Inc., 1988. Fish Habitat Characteristics and Salmonid Abundance in the Lolo Creek Study Area During Summer 1988. Prepared for US Forest Service, Clearwater National Forest, P.O. No. 43-0276-8-219. Orofino, ID.

Connor and Snyder, 2016. Summary of Idaho Forest Practice Act BMP Audits on the Clearwater National Forest 1990-2019. Unpublished report.

Croke, J., S. Mockler, P. Fogarty, and I. Takken. 2005. Sediment concentration changes in runoff pathways from a forest road network and the resultant spatial pattern of catchment connectivity. Geomorphology, 68, 257–268.

Daigle, P. 2010. A summary of the environmental impacts of raods, management responses, and research gaps: A literature review. BC Journal of Ecosystems and Management 10(3):65-89.

Elliot, W.J., Scheele, D.L. and Hall, D.E., 2000. The forest service WEPP interfaces. Paper 00-5021. St. Joseph, MI: American Society of Agricultural Engineers.

FEMAT, 1993. Forest ecosystem management: An ecological, economic, and social assessment. Report of the Forest Ecosystem Management Assessment Team. U. S. Department of Agriculture, Forest Service; U.S. Department of Commerce, Interior, and EPA.

Foltz, R.B., 1996. Traffic and no traffic on an aggregate surfaced road: sediment production differences. http://www.fao.org/docrep/X0622E/x0622e0i.htm

Foltz, R. B., K. A. Yanosek, and T. M. Brown. 2007. Sediment concentration and turbidity changes during culvert removals. Journal of Environmental Management 87 (2008) 329-340.

Good, T.P., R.S. Waples, and P. Adams (editors), 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead, US Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.

Goodrich, Betsy A., R.D. Koski, and W.R. Jacobi, 2009. Monitoring surface water chemistry near magnesium chloride dust suppressant treated roads in Colorado. Journal of Environmental Quality, Vol. 38, Issue 6; pp. 2373-2381.

Grace, J.M. III and B. D. Clinton. 2006. Forest Road Management to Protect Soil and Water. ASABE No. 068010. Presented at ASABE Annual International Meeting, Portland, OR, July 9-12, 2006.

Grant, G E.; S.L. Lewis, F.J. Swanson, J.H. Cissel, J.J. McDonnell. 2008. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. Gen. Tech. Rep. PNW-GTR-760. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 76 p.

Idaho Dept. of Environmental Quality, 2016. Idaho Interagency Forest Practices Water Quality Audit. Idaho Dept. of Environmental Quality. Boise, ID. https://www.idl.idaho.gov/forestry/fpa/index.html

Idaho Dept. of Environmental Quality, 2013. Idaho Interagency Forest Practices Water Quality Audit. Idaho Dept. of Environmental Quality. Boise, ID. https://www.idl.idaho.gov/forestry/fpa/index.html

Idaho Department of Fish and Game, 2018. Idaho anadromous parr monitoring 2017 annual report. IDFG Report Number 18-07. Boise, ID.

King, J. G. 1994. Streamflow and sediment yield responses to forest practices in north Idaho. In proceedings of Interior Cedar-Hemlock-White Pine Forest: Ecology and Mangement, held march 1993 in Spokane, WA. Department of Natural Resource Sciences, Washington State University, Pullman, WA 99164.

Lee, P., C. Smyth and S. Boutin. 2004. Quantitative review of riparian buffer width guidelines from Canada and the United States. Journal of Environmental Management 70 (2004) 165-180.

Lisle, T. E., J. M. Buffington, P.R. Wilcock, and K. Bunte, 2015. Can Rapid Assessment Protocols Be Used to Judge Sediment Impairment in Gravel-Bed Streams? A Commentary. Journal of the American Water Resources Association (JAWRA) 51(2): 373-387. DOI: 10.1111/jawr.12255

Luce, C.H. and T. A. Black, 2001. Spatial and temporal patterns in erosion from forest roads. In Influence of Urban and Forest Land Uses on the Hydrologic-Geomorphic Responses of Watersheds, Edited by M.S. Wigmosta and S.J. Burges. Water Resources Monographs, American Geophysical Union. Washington D.C. pp. 165-178.

MacDonald, L. 2005. Sediment production and delivery from unpaved forest roads in the Sierra Nevada, California. Geophysical Research Abstracts, Vol. 7, 088831

McClelland, Douglas E. and R. B. Foltz, W. D. Wilson, T. W. Cundy, R. Heinemann, J.A. Saurbier, and R.L. Schuster. 1997. Assessment of the 1995 & 1996 Floods and Landslides on the Clearwater National Forest. Part 1: Landslides. A Report to the Regional Forester, Northern Region, US Forest Service.

Meredith, C., E. Archer, and B. Roper, 2014. Reductions in instream wood in streams near roads in the Interior Columbia River Basin. North American Journal of Fisheries Management, 34:3, pp. 493-506. DOI: 10.1080/02755947.2014.882451.

Monlux, S. and M. Mitchell. 2007. Chloride stabilization of unpaved road aggregate surfacing. Transportation Research Record; Journal of the Transportation Research Board, No. 1989, Vol. 2. Transportation Research Board of the National Academies, Washington, D.C., 2007, pp. 50-58.

NOAA, 2017. ESA Recovery Plan for Snake River Spring/Summer Chinook Salmon and Snake River Basin Steelhead. US Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. West Coast Region. Portland, OR.

Ott, R., A. Ambourn, F. Keirn, A, Arians. 2005. Relevant Literature for and Evaluation of the Effectiveness of the Alaska Forest Resources and Practices Act: An Annotated Bibliography. Reference #404.

Patten, R. and Jones, R. 2005. Watershed Response Model for Forest Management. WATBAL Technical User Guide. Clearwater National Forest. Orofino, Idaho.

Reid, L. M., Ph.D., and T. Dunne. 1984. Sediment production from forest road surfaces. Water Resour. Res. 20(11), 1753-1761.

Sanders, T. and Addo, J. 1993. Effectiveness and Environmental Impact of Road Dust Suppressants. Department of Civil Engineering, Colorado State University. Ft. Collins, CO.

Scott, D.W., Schmitt, C.L., and L.H. Speigel. 2002. Factors affecting survival of fire injured trees: a rating system for determining relative probability of survival of conifers in the Blue and Wallawa Mountains. USDA Forest Service, Pacific Northwest Region. Wallowa-Whitman National Forest. Blue Mountains Pest Management Service Center. BMPMSC-03-01.

Sridhar, V., Sansone A.L., LaMarche, J., Dubin, T. and Lettenmaier, D.P. 2004. Prediction of Stream Temperatures in Forested Watersheds. Journal of the American Water Resources Association (JAWRA), 40(1):197-213.

Sugden, Brian R., 2018. Estimated Sediment Reduction with Forestry Best Management Practices Implementation on a Legacy Forest Road Network in the Northern Rocky Mountains. Forest Science 64(2):214-224.

Swift, L.W. Jr. and R.G. Burns. 1999. The three R's of roads: redesign, reconstruction, and restoration. Journal of Forestry 97(8):41-44

Switalski, T. A., J. A. Bissonette, T. H. DeLuca, C.H. Luce, and M.A. Madej. 2004. Benefits and impacts of road removal. Frontiers in Ecology and Environment 2(1):21-28.

USDA Forest Service. 2003 FY 2003 Monitoring and evaluation report. Clearwater National Forest, Orofino, ID: U.S. Department of Agriculture, Forest Service

USDA Forest Service, 2008. FY 2008 Monitoring and evaluation report. Clearwater National Forest, Orofino, ID: U.S. Department of Agriculture, Forest Service

USDA Forest Service, 2012. PIBO Effectiveness Monitoring Program for Streams and Riparian Areas. 2012 Annual Summary Report. Rocky Mountain Research Station. Fort Collins, CO.

USDA Forest Service, 2016. Habitat condition for sites in US Forest Service Region 1. PACFISH/INFISH Biological Opinion (PIBO) Effectiveness Monitoring Program. Logan, UT.

USDA Forest Service 2016a. PACFISH Buffer and Temporary Road Monitoring and Miscellaneous Timber Sale Observations Report. Nez Perce-Clearwater National Forest, Lochsa Ranger District. *Unpublished report…available in the project file.*

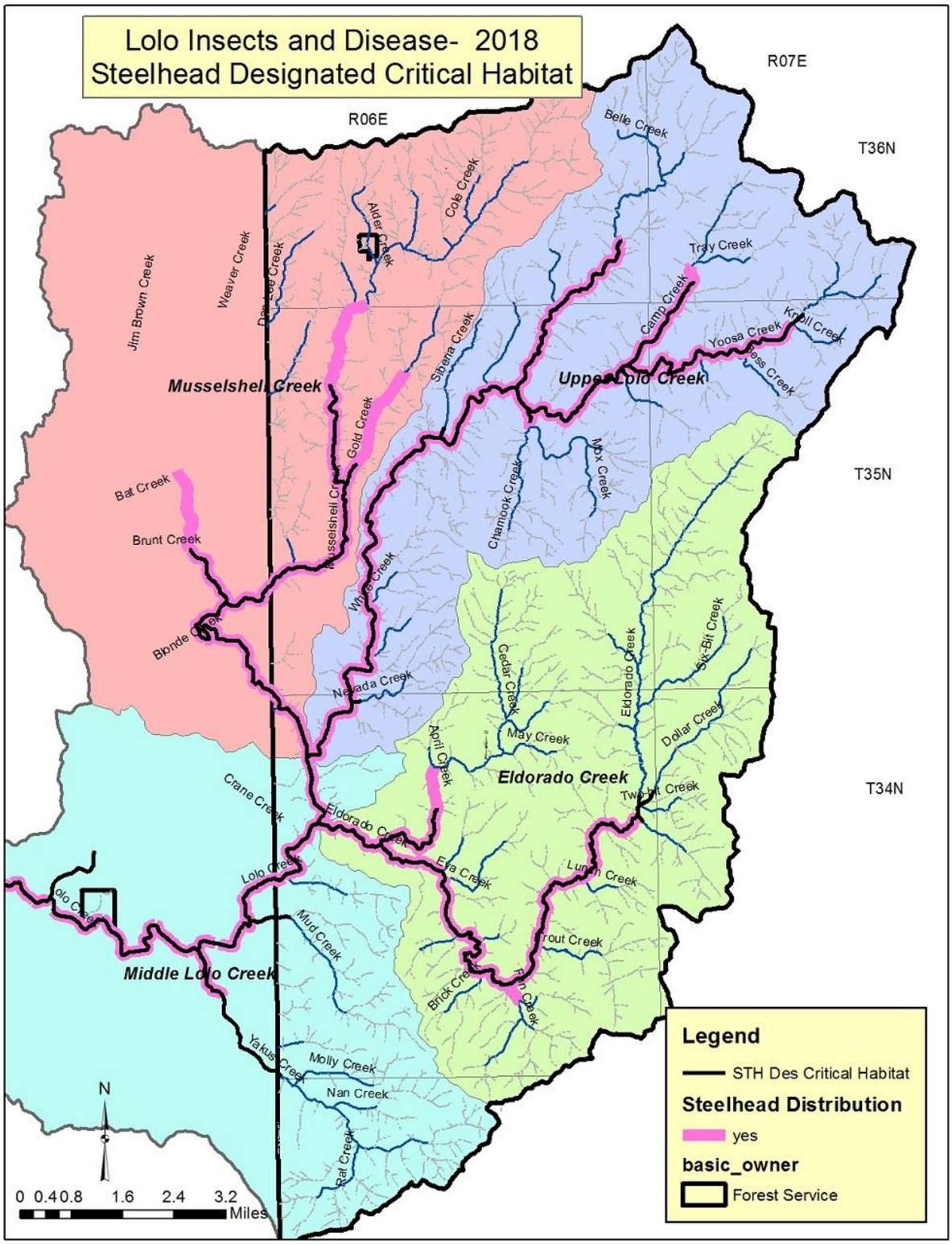
USDA Forest Service, 2016b. [Edwards, Pamela J., F Wood, and R. Quinlivan]. Effectiveness of Best Management Practices that have application to Forest roads: a literature synthesis. General Technical Report NRS-163, USDA Forest Service, Northern Research Station.

Walters, D, 2019. Hydrologist. US Forest Service, Lolo National Forest, Missoula, Montana. Personal communication.

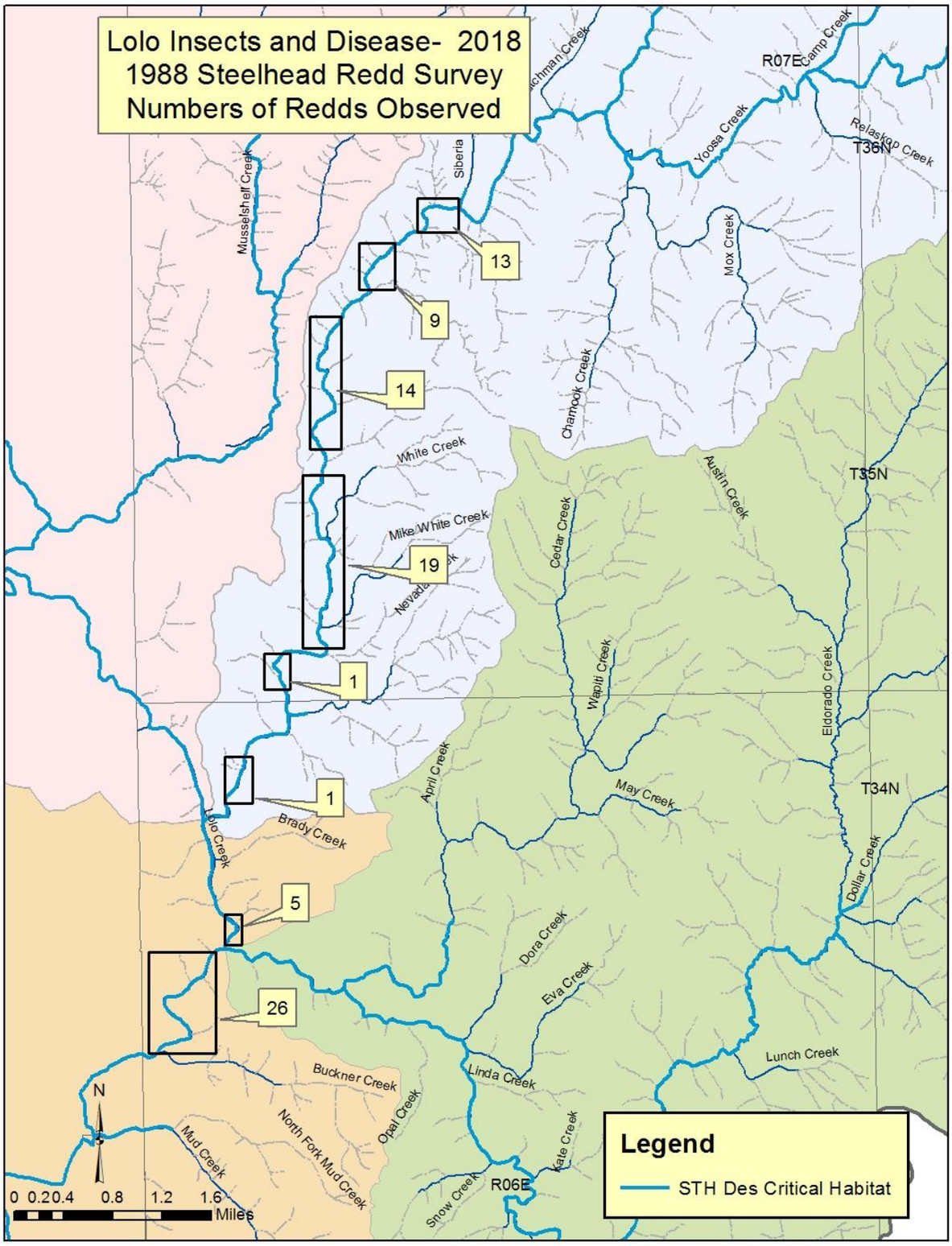
Young, M., 2019. Research Fisheries Biologist. Rocky Mountain Research Station Scientist, US Forest Service. Missoula Montana. Personal communication.

Appendix A: Maps of Proposed Activities for the Lolo Insect and Disease Project

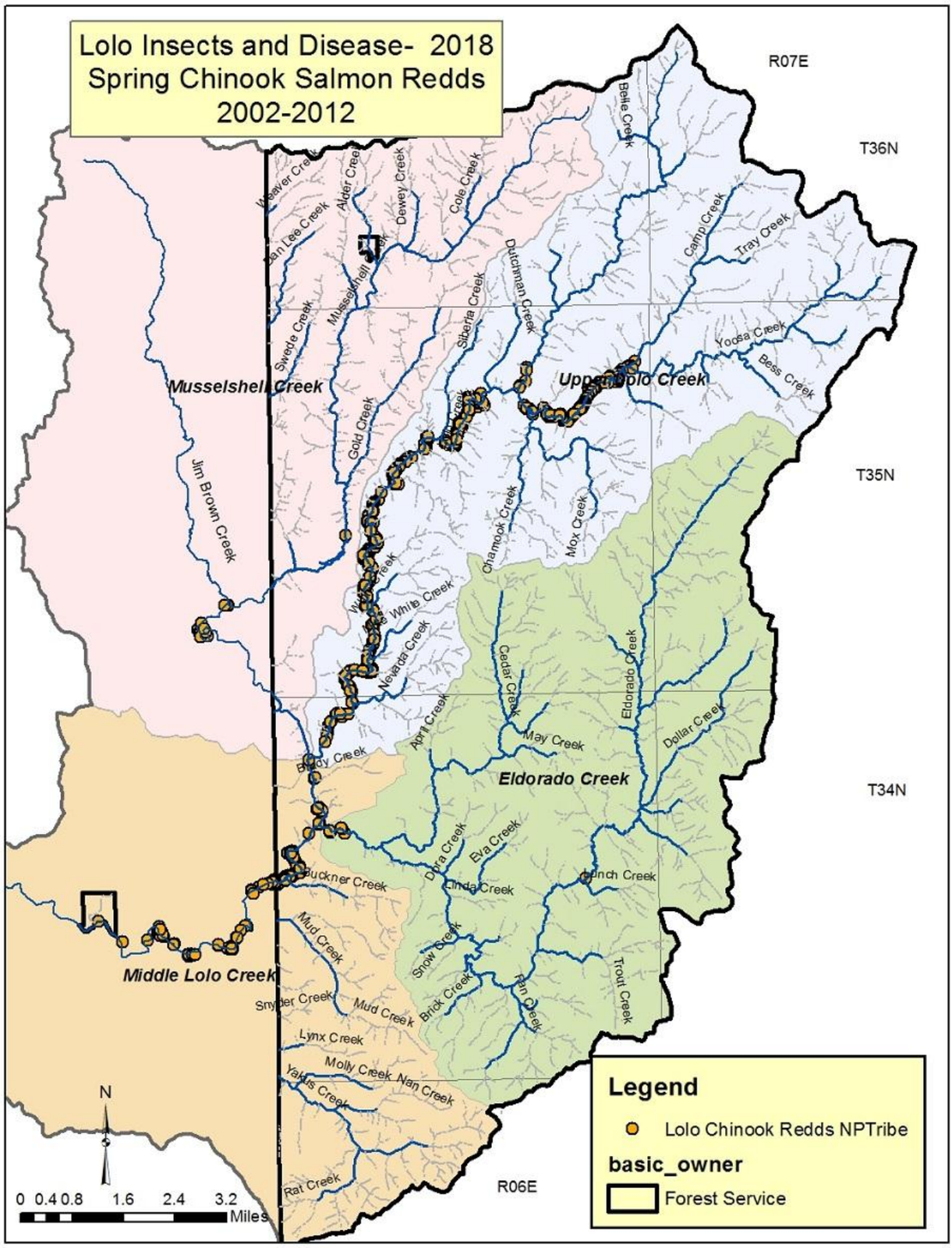
Map 1. Steelhead trout designated critical habitat and distribution in the Lolo Creek drainage.



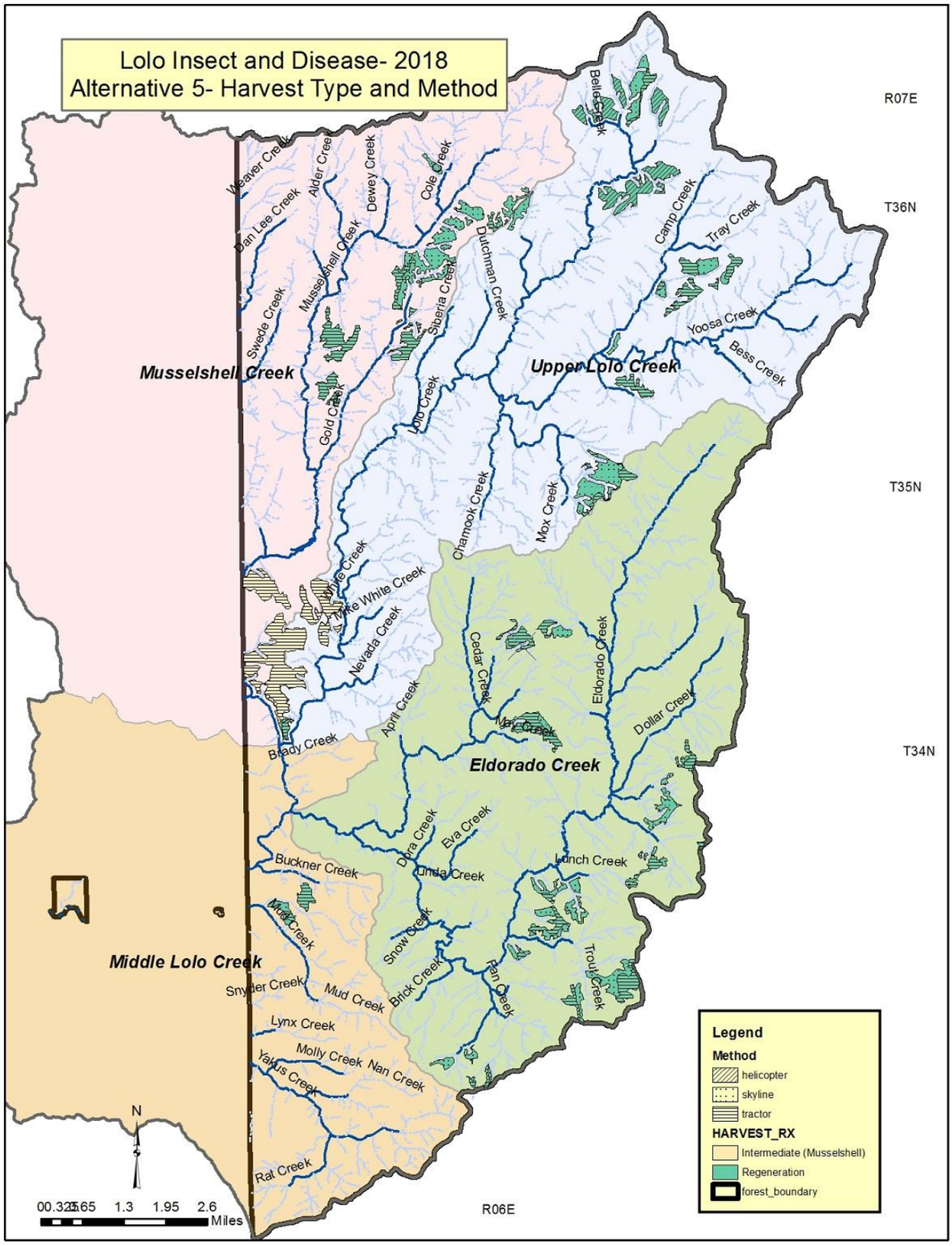
Map 1a. 1988 Steelhead redd survey. Numbers of redds observed.



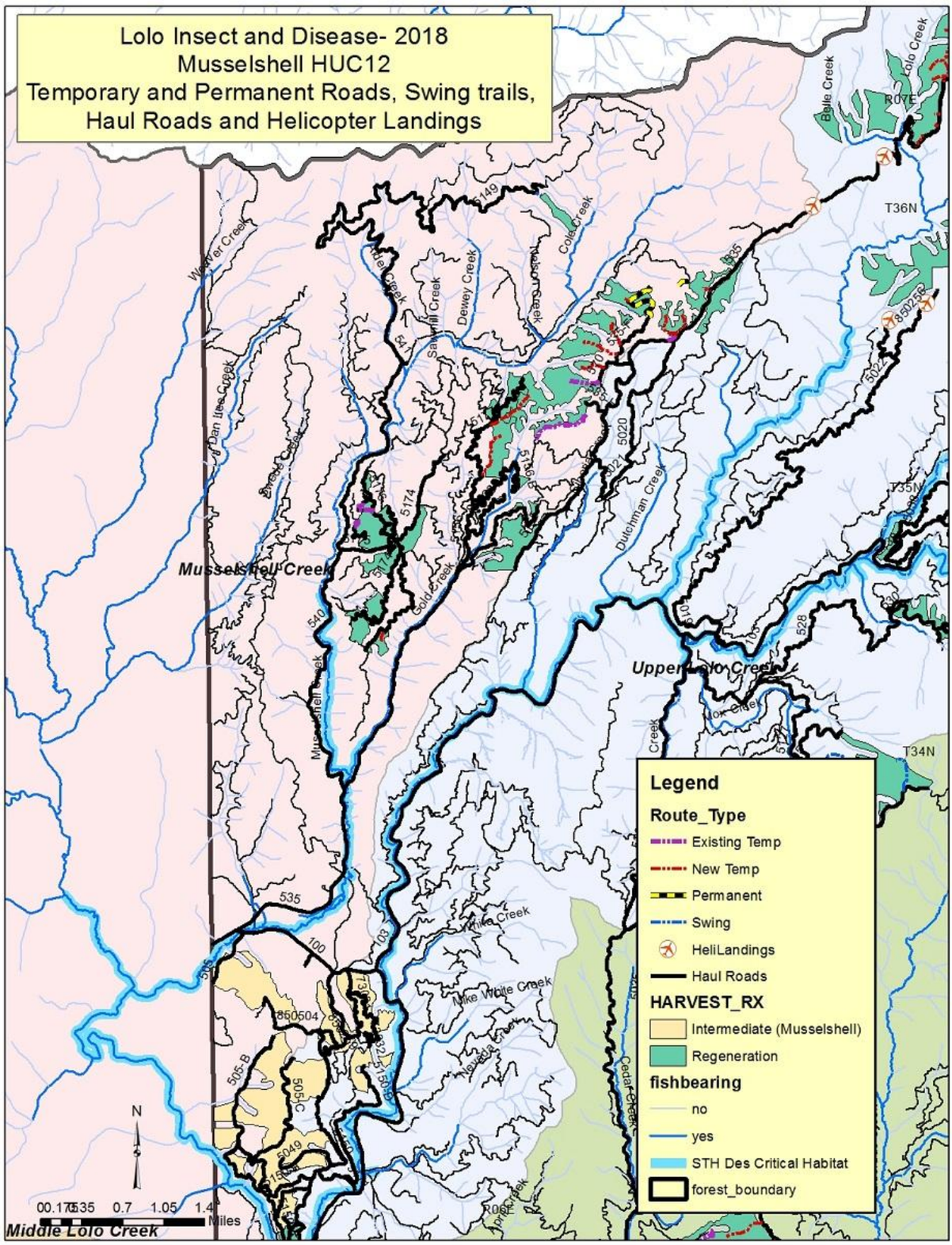
Map 2. Chinook Redds and assumed distribution (2002-2012).



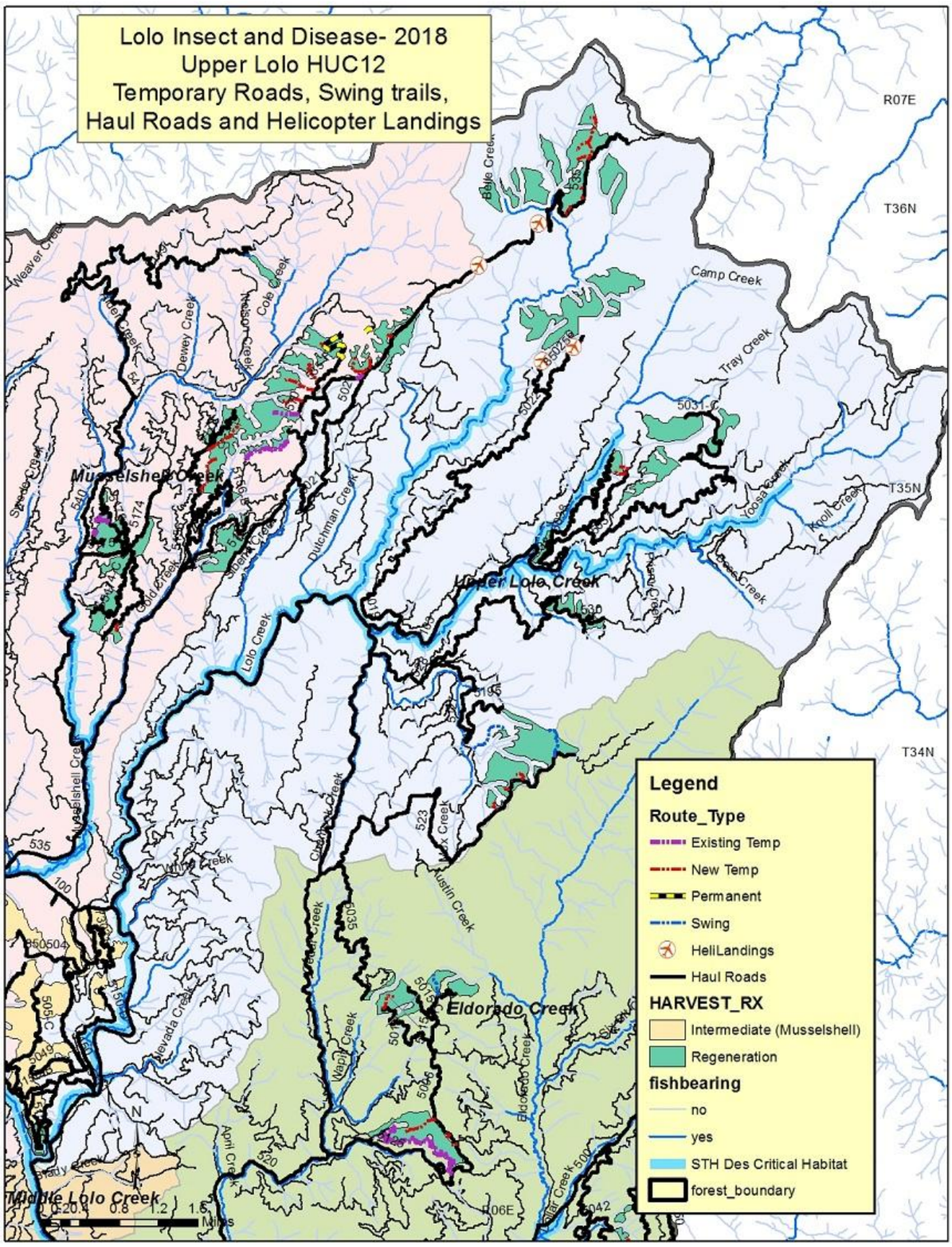
Map 3. Proposed harvest by type and method, Alternative 5.



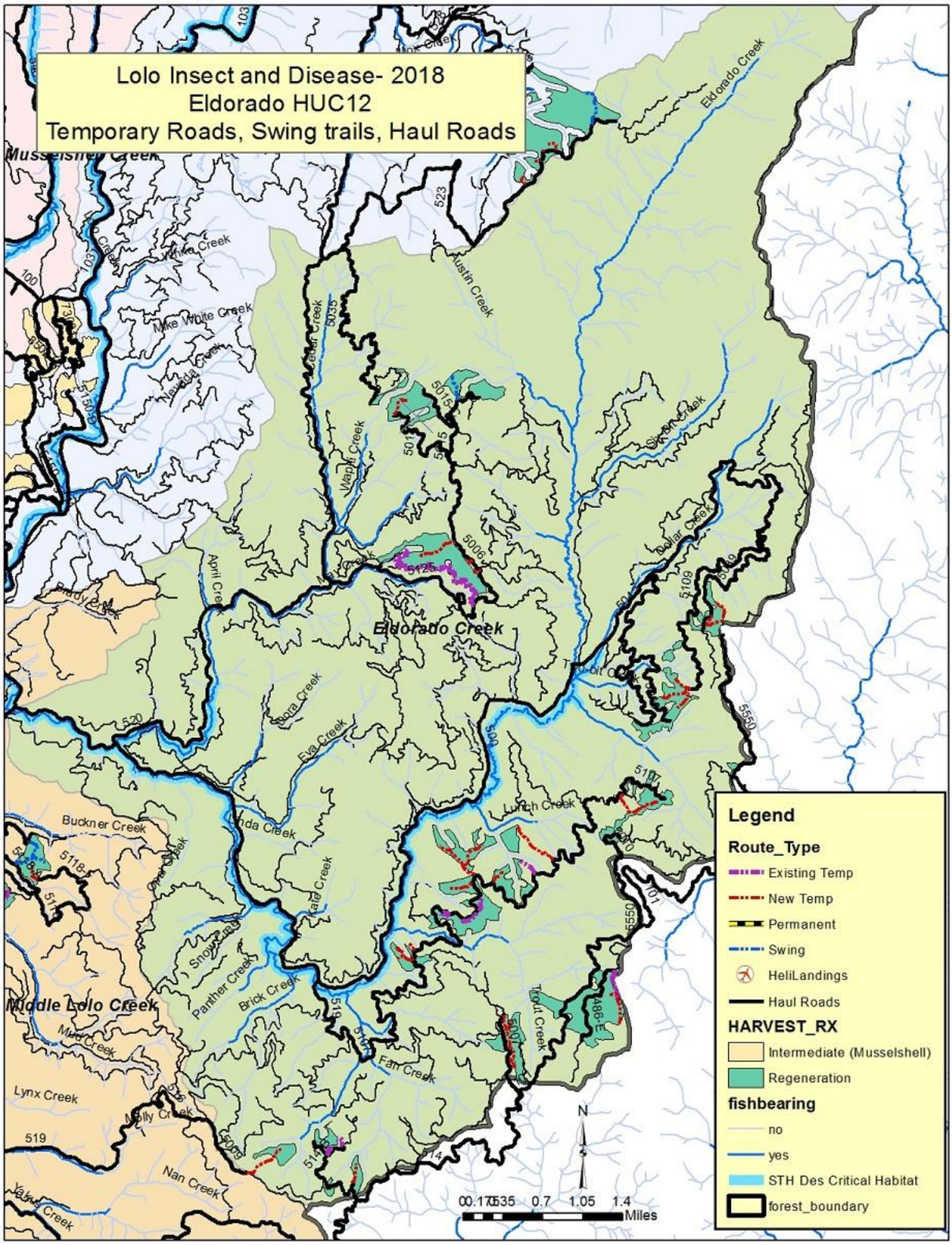
Map 4a. Musselshell HUC 12 Temporary and permanent roads, swing trails, haul roads and helicopter landings.



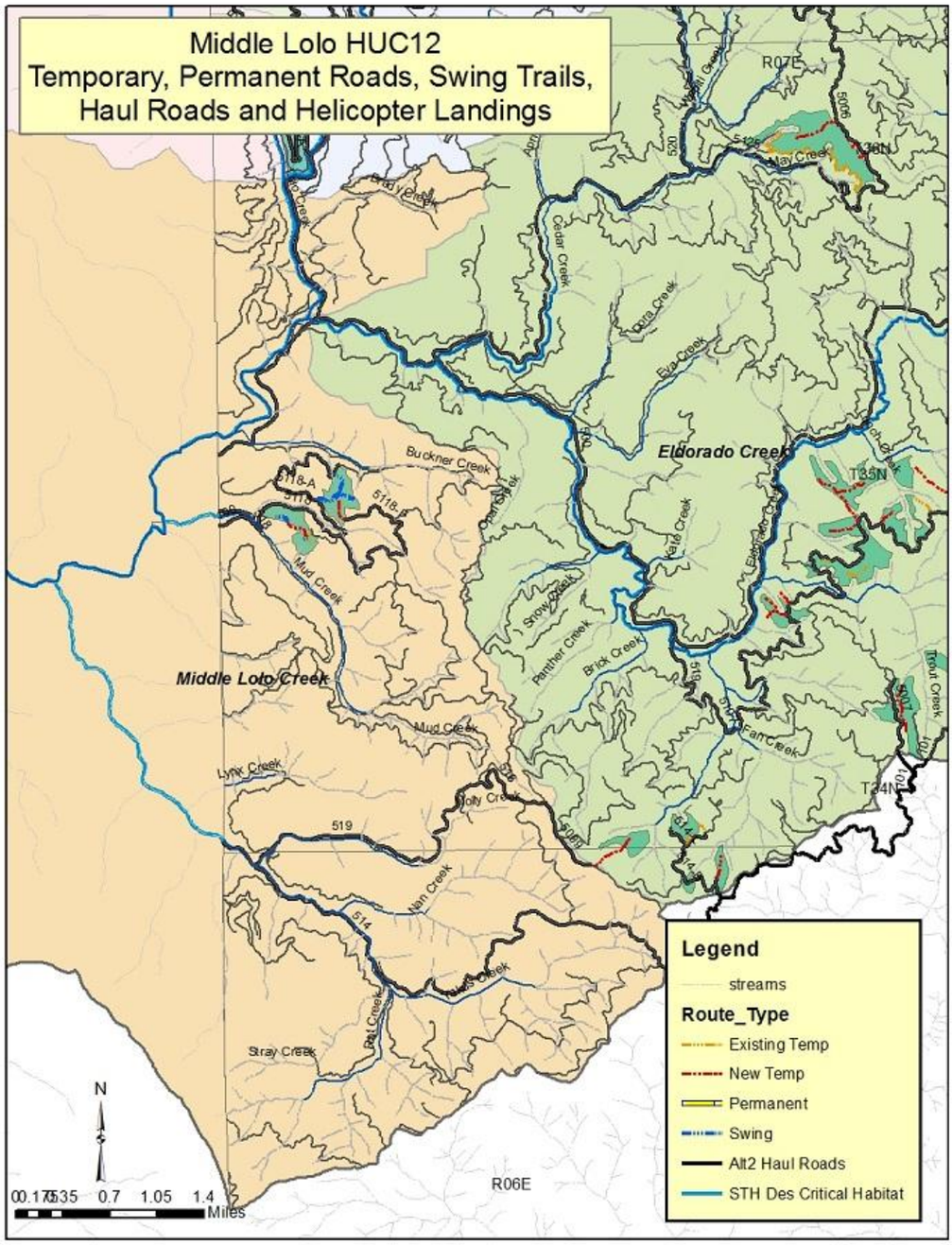
Map 4b. Upper Lolo HUC 12 Temporary roads, swing trails, haul roads and helicopter landings.



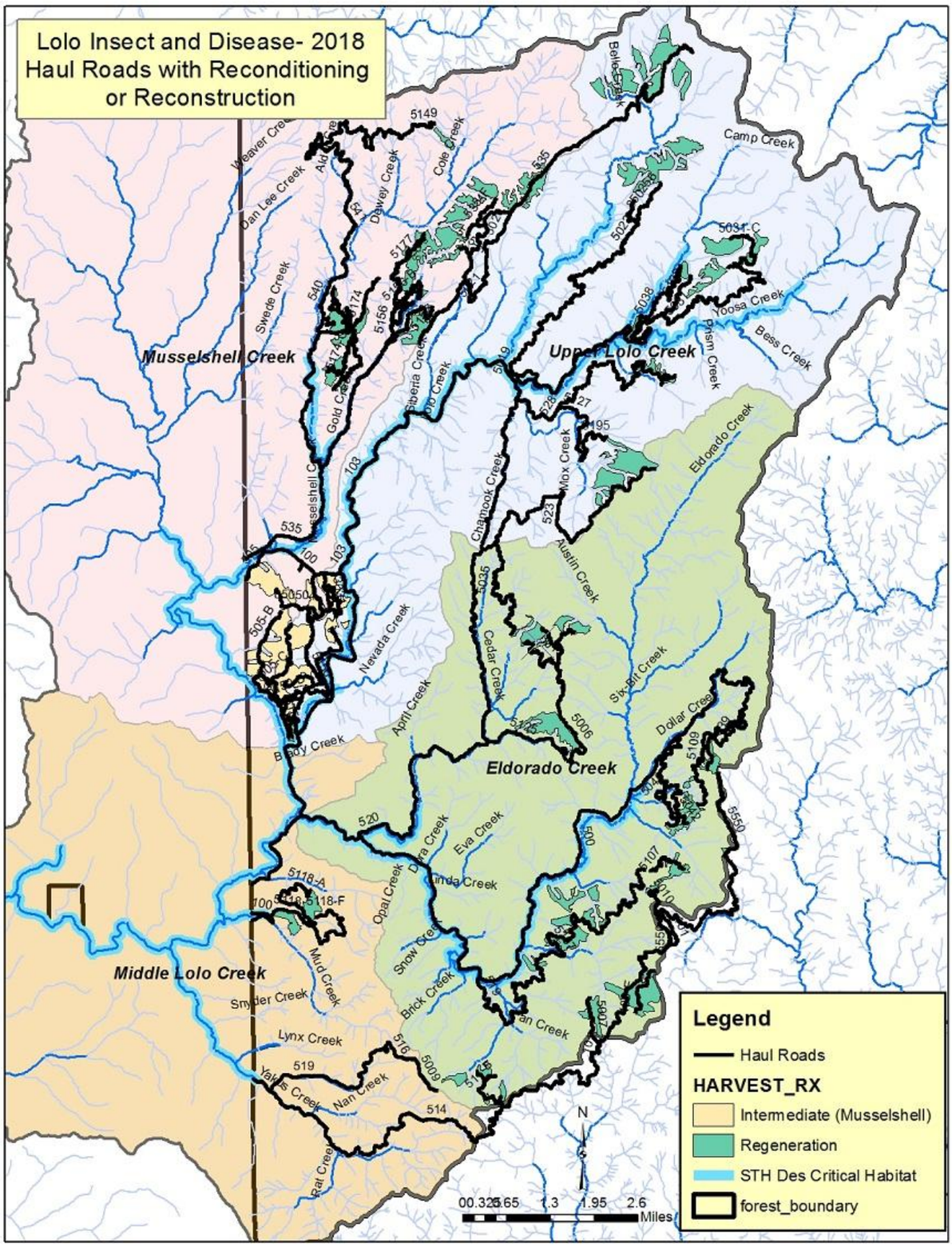
Map 4c. Eldorado HUC 12 Temporary roads, swing trails and haul roads.



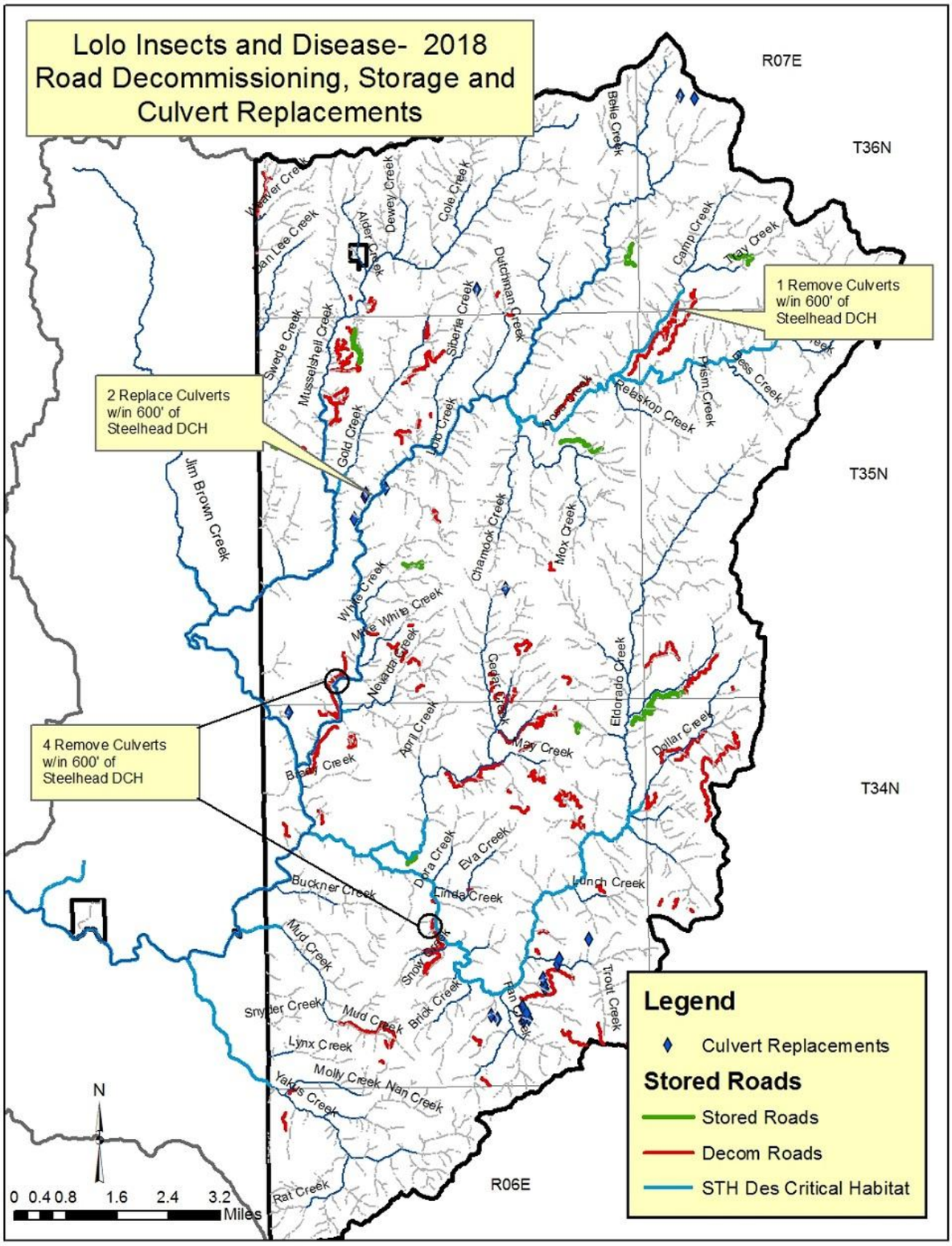
Map 4d. Middle Lolo HUC 12 Temporary roads, swing trails and haul roads.



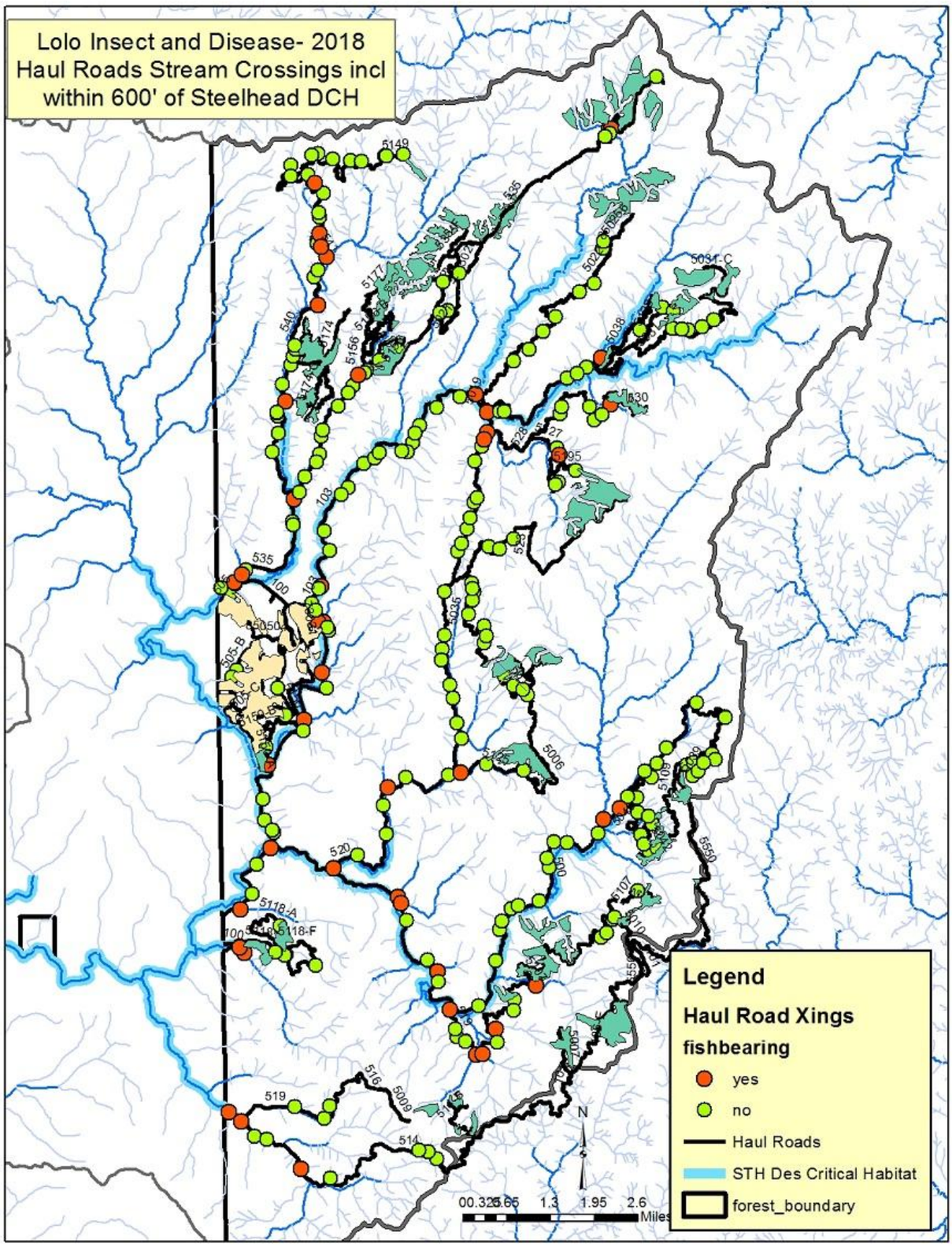
Map 5. Haul roads. All would receive either reconditioning or reconstruction, except 8 miles of Road 100 which is paved.



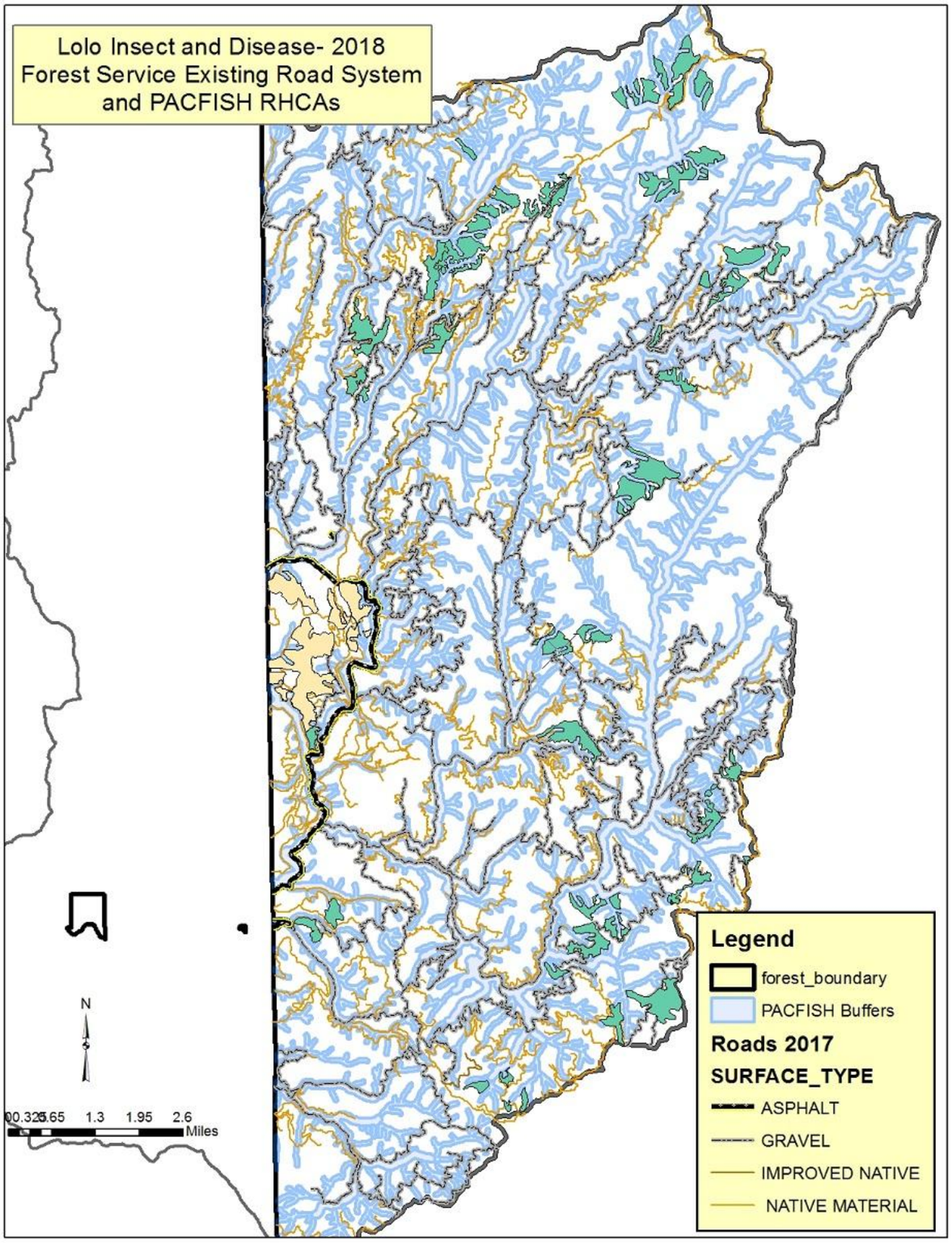
Map 6. Roads for decommissioning or storage, culvert replacements.



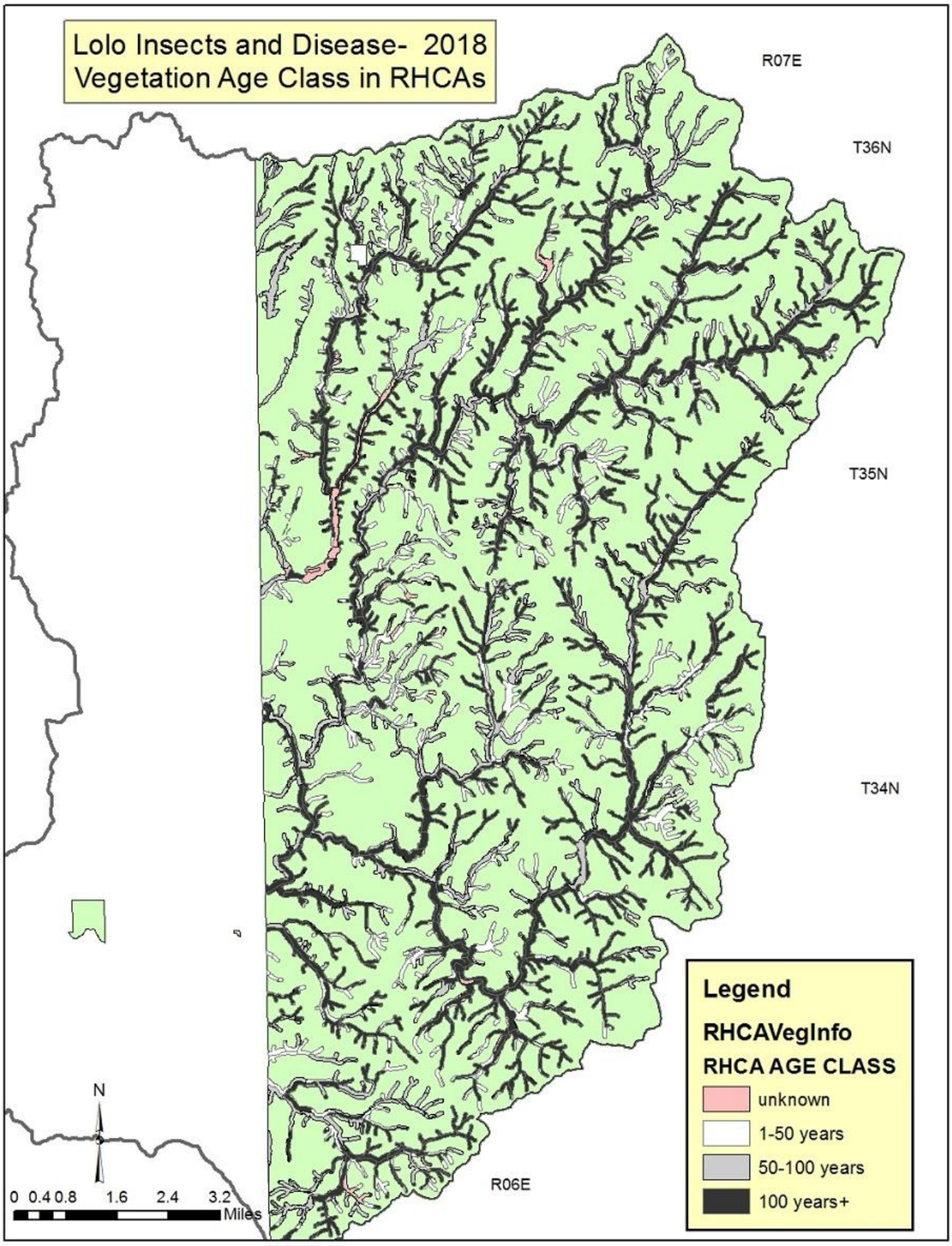
Map 7. Haul road stream crossings including those within 600' of steelhead designated critical habitat.



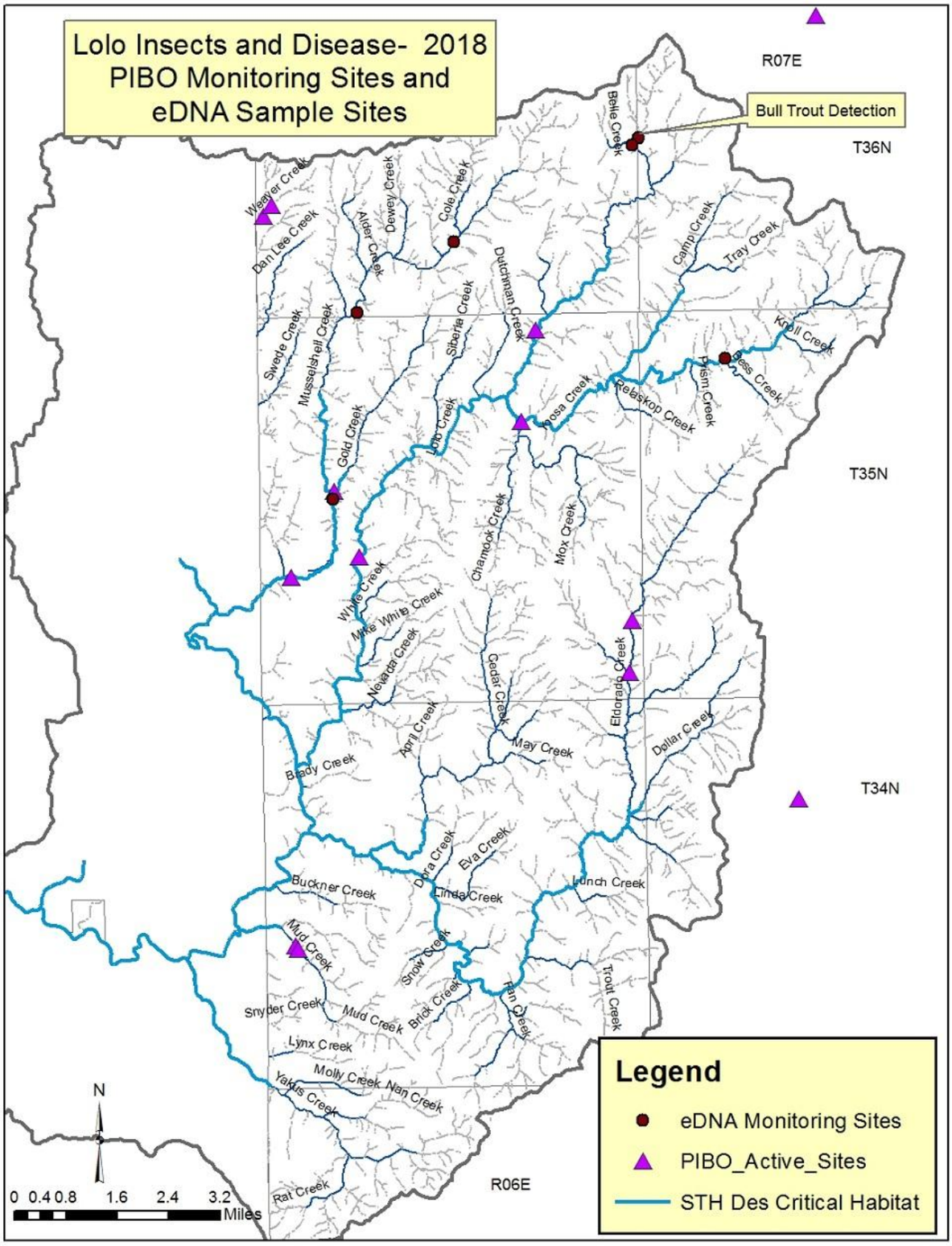
Map 8. Forest Service roads in the Lolo drainage but surface type.



Map 9. RHCA vegetation age class.



Map 10. PIBO monitoring sites and eDNA sample sites in the Lolo drainage.



Appendix B: Checklist for Documenting Environmental Baseline and Effects of Action(s) on Relevant Indicators.

Section 7 Matrix of Pathways and Indicators

Watershed Name: ***Lolo Cr (HUC10)***

Subbasin: Clearwater

PATHWAYS:	ENVIRONMENTAL BASELINE			EFFECTS OF THE ACTION(S)		
INDICATORS	High	Moderate	Low	Restore	Maintain	Degrade
Watershed Conditions:						
Watershed Road Density			X	X		
Streamside Road Density			4.6 mi/mi^2	4.3 mi/mi^2		
Landslideprone Road Density	0.1 mi/mi^2				0.1 mi/mi^2	
Riparian Veg Condition	X				X	
Peak/Base Flow						
Water Yield (ECA)		X			X	
Sediment Yield		X		X		
Channel Cond. & Dynamics:						
Width/Depth Ratio	X				X	
Streambank Stability	97%				X	
Floodplain Connectivity	X				X	
Water Quality:						
Temp - Steelhead Spawning		X			X	
Temp- Steelhead Rear/Migration			X		X	
Temperature - Bull Trout			I= X S=X R=X		X	
Suspended Sediment	X				X	
Chem. Contam./Nutrients	X				X	
Habitat Access:						
Physical Barriers - Adult		X			X	
Physical Barriers - Juvenile		X			X	
Habitat Elements:						
Cobble Embeddedness		24%			X	
Percent Surface Fines		ND				
Percent Fines by Depth						
Large Woody Debris		X			X	
Pool Frequency	24				X	
Pool Quality		X			X	
Off-channel Habitat		X			X	
Habitat Refugia	X				X	
Take:						
Harassment	B=X S=X				X	
Redd Disturbance	X				X	
Juvenile Harvest	X				X	
Bull Trout Subpopulation Characteristics & Habitat Integration:					X	
Subpopulation Size			X			
Growth and Survival			X		X	
Life History Diversity, Isolation			X		X	
Persistence & Genetic Integrity			X		X	
Integration of Species and Habitat Conditions		X			X	

Section 7 Matrix of Pathways and Indicators
Watershed Name: *Musselshell Cr (HUC12)*
Subbasin: Lolo Creek (Clearwater)

PATHWAYS:	ENVIRONMENTAL BASELINE			EFFECTS OF THE ACTION(S)		
INDICATORS	High	Moderate	Low	Restore	Maintain	Degrade
Watershed Conditions:						
Watershed Road Density			3.3 mi/mi^2	3.2 mi/mi^2		
Streamside Road Density			5.7 mi/mi^2	5.2 mi/mi^2		
Landslideprone Road Density	X				X	
Riparian Veg Condition		X			X	
Peak/Base Flow						
Water Yield (ECA)		19%				24%
Sediment Yield		ND		X		
Channel Cond. & Dynamics:						
Width/Depth Ratio	13				X	
Streambank Stability	100				X	
Floodplain Connectivity		X			X	
Water Quality:						
Temp - Steelhead Spawning		X			X	
Temp- Steelhead Rear/Migration			X		X	
Temperature - Bull Trout			I=X S=X R=X		X	
Suspended Sediment		ND			X	
Chem. Contam./Nutrients	X				X	
Habitat Access:						
Physical Barriers - Adult		X			X	
Physical Barriers - Juvenile		X			X	
Habitat Elements:						
Cobble Embeddedness			X		X	
Percent Surface Fines			X	Long term		Short term
Percent Fines by Depth						
Large Woody Debris	X				X	
Pool Frequency	50				X	
Pool Quality		X			X	
Off-channel Habitat		X			X	
Habitat Refugia		X			X	
Take:						
Harassment	S=X	B=X			X	
Redd Disturbance	X				X	
Juvenile Harvest	X				X	
Bull Trout Subpopulation Characteristics & Habitat Integration:			X		X	
Subpopulation Size						
Growth and Survival			X		X	
Life History Diversity, Isolation			X		X	
Persistence & Genetic Integrity			X		X	
Integration of Species and Habitat Conditions			X		X	

Section 7 Matrix of Pathways and Indicators
Watershed Name: *Upper Lolo Cr (HUC12)*
Subbasin: Lolo Creek (Clearwater)

PATHWAYS:	ENVIRONMENTAL BASELINE			EFFECTS OF THE ACTION(S)		
INDICATORS	High	Moderate	Low	Restore	Maintain	Degrade
Watershed Conditions:						
Watershed Road Density			4.1 mi/mi^2	3.8 mi/mi^2		
Streamside Road Density			4.0 mi/mi^2	3.8 mi/mi^2		
Landslideprone Road Density	X				X	
Riparian Veg Condition		X			X	
Peak/Base Flow						
Water Yield (ECA)	12%				14%	
Sediment Yield		ND			X	
Channel Cond. & Dynamics:						
Width/Depth Ratio	17				X	
Streambank Stability	98%				X	
Floodplain Connectivity		X			X	
Water Quality:						
Temp - Steelhead Spawning	X				X	
Temp- Steelhead Rear/Migration		X			X	
Temperature - Bull Trout		I=X R=X	S=X		X	
Suspended Sediment	N/D				X	
Chem. Contam./Nutrients	X				X	
Habitat Access:						
Physical Barriers - Adult	X			X		
Physical Barriers - Juvenile	X			X		
Habitat Elements:						
Cobble Embeddedness	51%		51%		X	
Percent Surface Fines			24%	Long term		Short term
Percent Fines by Depth						
Large Woody Debris	X					
Pool Frequency	46				X	
Pool Quality		X			X	
Off-channel Habitat	X				X	
Habitat Refugia	X				X	
Take:						
Harassment	B=X S=X					Short term @ culvert sites
Redd Disturbance	X				X	
Juvenile Harvest	X				X	
Bull Trout Subpopulation Characteristics & Habitat Integration:						
Subpopulation Size			X		X	
Growth and Survival			X		X	
Life History Diversity, Isolation			X		X	
Persistence & Genetic Integrity			X		X	
Integration of Species and Habitat Conditions		X			X	

Section 7 Matrix of Pathways and Indicators
Watershed Name: *Eldorado Cr (HUC12)*
Subbasin: Lolo Creek (Clearwater)

PATHWAYS:	ENVIRONMENTAL BASELINE			EFFECTS OF THE ACTION(S)		
INDICATORS	High	Moderate	Low	Restore	Maintain	Degrade
Watershed Conditions:						
Watershed Road Density			4.4 mi/mi^2	3.9 mi/mi^2		
Streamside Road Density			4.4 mi/mi^2	3.8 mi/mi^2		
Landslideprone Road Density	X			X		
Riparian Veg Condition		X			X	
Peak/Base Flow						
Water Yield (ECA)	9%				13%	
Sediment Yield		ND			X	
Channel Cond. & Dynamics:						
Width/Depth Ratio	7				X	
Streambank Stability	93%				X	
Floodplain Connectivity	X				X	
Water Quality:						
Temp - Steelhead Spawning		X			X	
Temp- Steelhead Rear/Migration			X		X	
Temperature - Bull Trout		I=X	I=X S=X R=X		X	
Suspended Sediment	ND			X		
Chem. Contam./Nutrients	X				X	
Habitat Access:						
Physical Barriers - Adult	X				X	
Physical Barriers - Juvenile	X				X	
Habitat Elements:						
Cobble Embeddedness		24%			X	
Percent Surface Fines			92%	Long term		Short term
Percent Fines by Depth						
Large Woody Debris	X				X	
Pool Frequency	79				X	
Pool Quality		X			X	
Off-channel Habitat	X				X	
Habitat Refugia	X				X	
Take:						
Harassment	B=X S=X				X	
Redd Disturbance	X				X	
Juvenile Harvest	X				X	
Bull Trout Subpopulation Characteristics & Habitat Integration:						
Subpopulation Size			X		X	
Growth and Survival			X		X	
Life History Diversity, Isolation			X		X	
Persistence & Genetic Integrity			X		X	
Integration of Species and Habitat Conditions			X		X	

Section 7 Matrix of Pathways and Indicators
Watershed Name: *Middle Lolo Cr (HUC12)*
Subbasin: Lolo Creek (Clearwater)

PATHWAYS:	ENVIRONMENTAL BASELINE			EFFECTS OF THE ACTION(S)		
INDICATORS	High	Moderate	Low	Restore	Maintain	Degrade
Watershed Conditions:						
Watershed Road Density			3.2 mi/mi^2		3.2 mi/mi^2	
Streamside Road Density			5.9 mi/mi^2	5.7 mi/mi^2		
Landslideprone Road Density	X				X	
Riparian Veg Condition		X			X	
Peak/Base Flow						
Water Yield (ECA)		17%			18%	
Sediment Yield					X	
Channel Cond. & Dynamics:						
Width/Depth Ratio	16				X	
Streambank Stability	95%				X	
Floodplain Connectivity	X				X	
Water Quality:						
Temp - Steelhead Spawning		X			X	
Temp- Steelhead Rear/Migration			X		X	
Temperature - Bull Trout			I=X S=X R=X		X	
Suspended Sediment	X				X	
Chem. Contam./Nutrients		N/D			X	
Habitat Access:						
Physical Barriers - Adult		X			X	
Physical Barriers - Juvenile		X			X	
Habitat Elements:						
Cobble Embeddedness		24%			X	
Percent Surface Fines		ND			X	
Percent Fines by Depth						
Large Woody Debris			X		X	
Pool Frequency			X		X	
Pool Quality			X		X	
Off-channel Habitat		ND			X	
Habitat Refugia		ND			X	
Take:						
Harassment	B=X S=X				X	
Redd Disturbance	X				X	
Juvenile Harvest	X				X	
Bull Trout Subpopulation Characteristics & Habitat Integration:						
Subpopulation Size			X		X	
Growth and Survival			X		X	
Life History Diversity, Isolation			X		X	
Persistence & Genetic Integrity			X		X	
Integration of Species and Habitat Conditions			X		X	

Appendix C: Lolo Insect and Disease Project Design Features and BMPs

Project Design Features

SOIL RESOURCES	
SR-1	Restrict activities when soils are wet to prevent resource damage (indicators include excessive rutting, soil displacement, and erosion).
SR-2	To reduce ground disturbance, no ground base logging (including mechanical falling and site preparation) would be allowed on slopes over 35%, unless mitigating measures such as operating on adequate compacted snow, operating equipment up and down slope, or operating only over short distances, are approved by the soil specialist on slopes up to 45%.
SR-3	Locate and design skid trails, landings and yarding corridors prior to activities to minimize the area of detrimental soil effects. Space tractor skid trails no less than 80 feet apart (edge to edge), except where converging on landings. This does not preclude the use of feller bunchers.
SR-4	Restrict equipment used for post-harvest excavator piling to existing trails and/or previously impacted areas.
SR-5	Ensure suspension of one end of the log when utilizing skyline yarding systems.
SR-6	Scarify and recontour excavated skid trails to restore slope hydrology and soil productivity.
SR-7	Scarify non-excavated skid trails and landings that are compacted or entrenched 3 inches or more. Scarify to a depth of 6 to 14 inches.
SR-8	All temporary roads will be scarified and recontoured (decommissioned) within 2 seasons of use. On both new temporary roads and existing temporary roads, reshape cut/fill slopes and crossings to natural contours. Apply available slash to the recontoured surface (slash is considered available where the equipment is able to reach it from the working area where the decommissioning is occurring).
SR-9	Allow winter logging only during frozen conditions. Frozen conditions are defined as 4 inches of frozen ground or a barrier of unpacked snow greater than two feet in depth and packed snow one foot in depth.
SR-10	Retain an average of 7 to 33 tons per acre of coarse woody debris (greater than 3 inches in diameter) following completion of activities in each unit.
SR-11	In all units, no harvest activities would occur in field-verified landslide prone areas. Landslide prone areas would be delineated in the field during unit layout and would be buffered as required under PACFISH. (PACFISH requires one site potential tree height buffers on landslide prone areas within key watersheds and no harvest on field verified landslide prone areas.)
WATER QUALITY AND FISH HABITAT	
WF-1	Avoid direct ignition of fuels within RHCA's. Allow prescribed fires to back into these areas.
WF-2	Cross drains will be installed and spaced no more than 100 feet on either side of stream crossings where necessary prior to other road work and haul to reduce road drainage area to streams.
WF-3	Dust abatement would be used on designated log haul routes in order to minimize the amount of road related sediment (via fugitive dust and road surface erosion) generated by log haul.
WF-4	Allow instream activities in fish bearing streams between July 15 and August 15 to avoid sediment deposition on emerging steelhead or Chinook redds. These dates may be site-specifically adjusted through coordination with Central Idaho Level 1 team review and approval.
WF-6	Temporary roads would be constructed on or near ridge tops with no stream crossings and would be hydrologically disconnected from any stream network. There would be no temporary road construction in RHCAs and roads would be located to avoid adverse effects to soil, water quality and riparian resources.
WILDLIFE	
WL-1	Snag retention will favor clusters (rather than solitary snags) within treatment units. Snag retention will be consistent with the Clearwater Forest Plan standard 5c; which is an average of 20 trees per acre across the landscape.
WL-2	Maintain a minimum 40 acre yearlong no activity buffer around recently occupied goshawk nest trees.
WL-3	No ground disturbing activities shall be allowed inside known occupied goshawk post-fledgling areas from April 15 to August 15.
ACCESS MANAGEMENT & PUBLIC SAFETY	
AM-1	Coordinate alternative snowmobile routes and/or access and parking with contractors and local organization(s) responsible for trail grooming when winter log haul occurs on roads normally used as groomed snowmobile routes. (Routes: 100, 101, 500, 514, 519, 520, 535, 540, 541, 5021, SNOW 854 (5150), SNOW 855 (5150-A), SNOW 856 (5150-B), SNOW 857 (5150-C))
AM-2	Protect all designated system trails within treatment units by requiring the following measures within 6 feet of centerline of the trail(s): Within 6 feet of the trail centerline (trail corridor) on both sides: limit equipment entries, utilize directional felling to minimize impact to the trail corridor and protect the trail tread, low cut stumps to 8 inches or less, and no slash piling. (Trails: 48, 58, 850, 851, 852, 854, 855, 856, 857 and along any road segments that also serve as designated trail routes: 514-B/J/K/L, 535, 570, 5010, 5038, 5043, 5107, 5117-A, 5118-E/F, 5154-G, 5156-B, 5174-B/C, 5176, 5176-A, 5550). Show these trails as protected improvements in the sale contract.

AM-3	Close existing gates (consistent with current motor vehicle restrictions) daily during non-operating hours.
AM-4	Require timber sale purchaser or stewardship contractor to post warning signs advising of equipment operations or hazards for public safety. (Timber Sale Contract Provision, currently B6.33)
AM-5	Roads scheduled for decommissioning shall retain an 18-24 inch access path along the decommissioned route to facilitate game movement and hiker travel.
NOXIOUS WEEDS	
NW-1	Remove all mud, soil, and plant parts from off road equipment before moving into project area to limit the spread of noxious weeds. Conduct cleaning off National Forest lands. (Timber Sale contract provision, currently B6.35)
NW-2	Use Forest Service approved native plant species/seed or non-native annual species/seed to meet erosion control needs and other management objectives. Apply only certified weed-free seed and mulch. (Timber Sale Contract Provision, currently C6.601)
NW-3	Visually inspect rock used for surfacing for presence of noxious weeds. Only use gravel-free noxious weeds..
CULTURAL RESOURCES	
CR-1	Halt ground-disturbing activities if cultural resources are discovered until an approved Archaeologist can properly evaluate and document the resources in compliance with 36 CFR 800. (Timber Sale contract provision, currently B6.24).
CR-2	Avoid or protect known historic properties or sites within units 2a, 4a, 4b, 4c, 4d, 8b, 9b, 105a (details are listed in the cultural resource report in the project record). (Timber Sale contract provision, currently B6.24). Coordinate with the zone archeologist.
CR-3	Where units (1e, 4a, 4f, 4g, 8b, 9b, and 202g) are alongside Forest Service Roads 535, 5155, and 5550, a 100 foot wide no harvest, limited access buffer would be applied on both sides of the roads to protect the integrity and context of the historic Lolo Motorway (applies to Alternatives 2 and 4).
SCENIC QUALITY	
SQ-1	Within retention viewsheds (within the Landmark Corridor), harvest areas within the immediate foreground of the viewing platform, (i.e., road, recreation sites, or administrative site), stumps should be cut to 8 inches or less in height (applies to Alternatives 3 and 4, units 2a,8b, and 105A)).
SQ-2	Within retention viewsheds (within the Landmark Corridor), landing areas within 200 feet of the viewing platform (i.e., road, recreation sites, or administrative sites) slash, root wads, and other debris should be removed, buried, burned, chipped or lopped to a height of 2 feet or less (applies to Alternatives 3 and 4, units 8b and 105A).
SQ-3	Within retention viewsheds where skyline harvest methods are used, minimize the number of skyline corridors in visually sensitive areas (applies to Alternatives 3 and 4, Units 8b and 105A).
SQ-4	Within all viewsheds, created openings within treatment units should not be symmetrical in shape and should meet the appropriate VQO designated in the Forest Plan (**Error! Reference source not found.** and VQO map that is located in the project record). Straight lines and right angles should be avoided. Created openings should resemble the size and shape of those found in the surrounding natural landscape in order to meet the designated VQO for that area. Treatments should follow natural topographic breaks and changes in vegetation if possible.

Additional Best Management Practices (BMPs) Associated with Protecting Water Quality

1) PACFISH default buffers would be used to define timber sale unit boundaries. No timber harvest would occur within 300 feet of fish-bearing streams, 150 feet of perennial non-fish bearing water, 100 feet of intermittent streams, and 150-foot slope distance from the edge of wetlands larger than one acre.

2) BMPs as found in Rules Pertaining to the Idaho Forest Practices Act Title 38, Chapter 13, Idaho Code, and Soil and Water Conservation Practices (SWCP) Handbook, FSH 2509.22 would be applied to prevent non-channelized sediment delivery from harvest units to streams in the Project area.

3) Contractors would have spill prevention and containment materials on site to minimize the risk of an accidental spill of petroleum products, as well as to protect water courses and aquatic biota from adverse effects in the event of a spill.

4) During road decommissioning or culvert replacements, measures to prevent damaging levels of sediment from entering streams would be undertaken, such as: (a) conducting work during the summer low flow period; (b) placing removable sediment traps below work areas to trap fines; (c) when working instream, removing all fill around pipes prior to bypass and pipe removal (where this is not possible, use non-eroding diversion); (d) dewatering work sites prior to culvert removal; (e) slow re-rewatering of sites upon completion of culvert installation; (f) re-vegetating scarified and disturbed soils with weed-free grasses for short-term erosion protection and with shrubs and trees for long-term soil stability; (g) utilizing erosion control mats on stream channel slopes and slides; (h) mulching with native materials, where available, or using weed-free straw to ensure coverage of exposed soils; (i) dissipating energy in the newly constructed stream channels using log or rock weirs; and (j) armoring channel banks and dissipating energy with large rock whenever possible.

   Culvert replacements and removal at 6 sites within 600’ of occupied steelhead critical habitat on Lolo and Eldorado Creeks would not occur prior to July 15 to protect steelhead or their designated critical habitat downstream (see Map 1, Appendix A).

5) There are an expected 3 timber sales that would be generated from the Lolo Insect and Disease Project. Depending on where the sale located, roads needed for the sale would be reconstructed prior to timber harvest.